HISTORIC AMERICAN ENGINEERING RECORD

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Adirondack Iron and Steel Company:
"New Furnace", 1849-1854
On Hudson River, 14 miles North of Newcomb
Tahawus
Essex County
New York

HAER NY-123

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
Heritage Conservation and Recreation Service
Department of the Interior
Washington, D.C. 20243

# HISTORIC AMERICAN ENGINEERING RECORD

## ADIRONDACK IRON AND STEEL COMPANY: "NEW FURNACE", 1849-1854

NY-123

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|---|---|
| Location: | Tahawus, New York<br>UTM: 18.575480.4881400<br>Quad: Santanoni |
| Date of Construction: | 1849-1854 |
| Present Owner: | NL Industries, Inc. |
| Significance: | The surviving remains of the "New Furnace" contain several very rare items, including the stack, a Nielsen-type hot blast stove, and the blowing engine, built by the Hudson River Iron and Machine Company of Ft. Edward, New York. During the 1850s the American iron industry witnessed the change from a charcoal-burning to a coal-burning smelting process. The site clearly portrays this historical transition in technology. |
| Historian: | Bruce Seely, 1978. |

## ACKNOWLEDGEMENT

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## INTRODUCTION

Near Tahawus, New York, north of the village of Newcomb in the Adirondack Park's high peaks district, stand the ruins of the Adirondack Iron and Steel Company's facilities. Little remains of the village called Adirondac, but more extensive reminders of the iron works have survived the ravages of time and nature. From 1832 to 1855, the partners of the company struggled to produce iron here. The presence of the iron works surprises many people. This region of clear-flowing rivers and a multitude of lakes is one of the vacation meccas of the East, continuing a tradition dating to the second quarter of the nineteenth century, as an exhibit opened in 1978 by the Adirondack Museum, entitled "Woods and Waters: Outdoor Recreation in the Adirondacks, 1830-1932," made clear. The only people to see the large stone blast furnace stack still standing next to the road are hikers and backpackers headed for the trails surrounding Mount Marcy, the highest point in New York State. And a few people recognize what it is. Certainly, the sylvan setting of the works, now re-covered by second growth forests, makes this site a most beautiful location for an iron works.

But the Adirondack Iron and Steel Company was only one of many iron companies that operated in the Adirondacks during the nineteenth century. Although the logging heritage received much of the attention, throughout the century New York ranks high among the states in the manufacture of iron. The various census reports, although notoriously unreliable, provided an indication of the relative magnitude of the size of New York's iron industry. In 1850, New York stood first in the number of foundries, second in forges, miscellaneous iron mining, and fourth in the number of blast furnaces in the country. By 1870, only Pennsylvania outranked New York in the total value of iron products. The 1880 figures showed that Ohio had eclipsed New York for the second spot, but the Empire State continued to hold the first position for forge and bloomary production, with 31,580 tons of blooms and bar iron.[1]

From the 1840's, New York's iron industry centered on the northern reaches of the state, especially near the western shore of Lake Champlain, in attempts to exploit the rich iron ore deposits underlying most of that region. Essex and Clinton Counties were the center of these enterprises, usually consisting of small bloomary forges. By 1845, Essex County boasted 33 iron works producing products worth $431,300, while Clinton County counted 29 iron works turning out $721,450 worth of iron products.[2] The Adirondack region remained relatively significant in iron output up to the Depression of the 1890s, by which time competitive pressures from cheaper and more easily transported ores from Minnesota and Wisconsin had forced most of the remaining works to close. By 1900 the Adirondack region was relegated to backwater status in an industry then centered on Pittsburgh and the Great Lakes.

The Adirondack Iron and Steel Company was one of the largest and most ambitious of the pre-Civil War efforts to work the Adirondack ores. This firm's significance lies not just in its size, however. Through a fortunate chain of circumstances, primarily related to its isolated location, the iron works site has been relatively undisturbed during the 125 years since it closed. A number of very rare pieces of technological hardware were thus spared the scrap yard. From them, the layout and arrangement of the site can be accurately determined. The individual pieces remain in excellent condition, and in the original location, enabling the historian to sense the overall context of the operation, especially its isolated, wilderness setting. Moreover, the Adirondack Museum in Blue Mountain Lake, N.Y. possesses a fairly thorough collection of the personal correspondence of the proprietors and managers of the concern. An excellent opportunity is thus presented to combine the wealth of detail contained in the traditional historian's sources with the information to be gained from a study of the iron works site itself. This important material offers an insight into how the owners made thier decisions, what their goals and hopes were, what motivated their efforts, and what problems they faced. In all, a reasonably thorough picture of the Adirondack Iron and Steel Works emerges. Because the second furnace and associated features have survived in much better condition than the other structures of Adirondac, the HAER drawings show only that part of the works. But the report covers the entire history of the firm.

FOOTNOTES

1. U. S. Department of the Interior, Census Office, Abstract of the Statistics of Manufactures According to the Returns of the Seventh Census, (Washington, 1850), pp. 63-67; Ninth Census, Volume III, "The Statistics of the WEalth and Industry of the United States," (Washington, 1872), p. 444; Tenth Census, Volume II, "Report of the Manufactures of the United States at the Tenth Census," (Washington, 1833), James M. Swank, "Statistics of the Iron and Steel Production of the United States," pp. 10-25.

2. New York State, Secretary of State, Census of the State of New York for 1845, (Albany, 1846).

# CHAPTER 1

The Adirondack region of northern New York State was almost the last area of land on the eastern seaboard to be settled. Although strategically located between the Mohawk and Hudson Rivers, few roads penetrated the wilderness forests, for the water routes of Lake Champlain and later the Erie Canal touched only the boundaries. Logging came later to this area; more noted were the hunting and excellent fishing that enticed downstate sportsmen to the woods. Henry Jarvis Raymond, editor of the New York Daily Times could still write in 1855,

> It may possibly be known to one in a hundred readers of the Times, that within the State of New York, and beginning within fifty miles of its capital, lies a tract of country larger than Connecticut, of as good soil as Western New York, heavily covered with as good timber as can be found in the forests of Maine, more copiously watered by beautiful lakes and streams than any other section of the United States, yet as unsettled as Nebraska, and less known than the newest state on the western borders of the American Union. Of those who are aware of this fact in a general way, not one in a thousand has ever traversed this region, or acquired any more accurate knowledge of its location and character than half an hour's reading of some sportsman's apochryphal narrative can give them.[1]

Nonetheless, like most every part of the United States iron ore was found in the Adirondacks, and the ore deposits attracted entrepreneurs willing to make the attempt to smelt that ore. The whole western shore of Lake Champlain attracted a number of early iron works, as did the Au Sable River in the town of Wilmington. The Adirondack Iron and Steel Company was one of these attempts, although located well inland from the lake, in the town of Newcomb. Three individuals, all of them Scotsmen, occupied the spotlight at the center of the company's affairs. First and foremost stood Archibald W. McIntyre, the primary owner and financial supporter of the concern. McIntyre was born in Perthshire, Scotland on 1 June, 1772, but grew up in Broadalbin, New York after his parents immigrated to America in 1774. A state legislator in 1799, McIntyre was appointed State Comptroller in 1806, a post he held with distinction until 1821. Until quite recently, his was the longest tenure in that position. After a short stint back in the legislature in 1823, McIntyre devoted the remainder of his life to a number of business endeavors, most notably the iron works.[2]

The second partner in this company was David Henderson, McIntyre's son-in-law. Henderson's background is unclear, but he had settled in Jersey City, New Jersey by the 1820s. Like McIntyre, Henderson was involved in other commercial ventures, including the formation of the first successful commercial pottery in this country.[3] The third initial owner was McIntyre's brother-in-law, a state legislator and one-time judge, Duncan McMartin, also of Broadalbin.[4] McMartin, of the three original owners, was the one most involved in the daily activities of the concern, actually supervising most of the initial construction.

Both Henderson and McMartin had previously engaged in business ventures with McIntyre, in the most unusual pattern of capital-raising before banks were readily available. McIntyre and McMartin built a woolen mill in Broadalbin about 1813.[5] During the 1820s, Henderson worked for the lottery to which McIntyre had been appointed agent, and which operated at least in New Jersey, Connecticut, New York, Pennsylvania and Delaware. But, in 1833 the New York and Pennsylvania lotteries closed as states began to legislate against such activity. McIntyre and Henderson may be among those meant when Harriet Eaton wrote in her history of Jersey City,

> Some of Jersey City's most reputable people were engaged in lotteries and accumulated fortunes in the business. Later the Legislature passed laws making it illegal and the parties then conducting a lottery in Jersey City removed their business to Wilmington, Delaware, where it was carried on for many years.[6]

The success of the lottery may be very important in explaining where the heavy outlays for financing the iron works originated.

The story of the iron works formally began in 1826 with the discovery of the ore beds some 10 miles below the source of the Hudson River in the High Peaks region of the Adirondack Mountains. A first-person account of this expedition in a letter by David Henderson, has been printed in numerous places over the years as one of the great tales of the Adirondacks.[7] The letter told how John McIntyre, (Archibald's brother), Henderson, and several others left North Elba - now Lake Placid, New York in October, 1826, and crossed through what is now called Indian Pass to reach a spot between the present Lakes Henderson and Sanford on the Hudson River in the town of Newcomb. The location was only 10 miles from Mount Marcy. Here they found, ". . . the most extraordinary bed of iron ore, for singularity of situation and extent of vein, which perhaps this North American Continent affords." The story has all the necessary elements of romance and adventure. An Indian had come to their cabin with a small piece of ore and said,"'You want see 'em ore - me know 'em bed, all same." While the party felt this offer was highly humorous, Henderson and the others eventually decided to follow the Indian ". . . on a wild goose chase . . .", paying their guide ". . .Dollar, half & 'bacco. . ." The Indian did indeed show them where the ore outcropped and formed a dam across the Hudson River. A quick inspection indicated the Highly excited, the party returned to North Elba.

It is interesting to pause here to add some background to the story. Importantly, Henderson and the others were in North Elba because Archibald McIntyre had started an iron forge on the banks of the Au Sable River there about 1810.[8] Though meeting some initial success during the War of 1812, financial difficulties soon intervened, and McIntyre eventually paid off a $4000 debt on the property. McIntyre and his associates last made iron there about 1816, although they rented the forge to their agent, Eleazer Darwin, who may have produced iron for another 10 years. The property consisted of 2219.26 acres with 2 forges and tilt-hammers under one roof, 3 coal houses, dwellings, boarding house, 2 barns, blacksmith shop, a saw mill and grist mill.[9] The arrangements followed by the Elba Iron Works are worth noting, for not only did they copy the traditional "iron plantation" pattern typical of late-17th and early-18th century iron works, but they also served as a model for things to come in the Adirondack Company's operations.

The other key point explaining the presence of the Henderson party at North Elba in 1826 was a rumor about the discovery of silver near-by. As Mary Mackenzie wrote,

> Their mission: Find the "lost" silver mine discovered by William Scott while hunting moose in the Elba woods. Scott, in the way of such matters had never been able to trace his route back to the mine. He had, however, revealed its general location before his untimely death in 1825.[10]

The silver hunt casts some light on the outlook and motivations of the proprietors of the works. In some ways, these men matched the stereotyped image of the grizzled western prospector, being true pioneers with the optimistic dream that striking it rich lay only over the next ridge. But as will be seen, the stereotype falls far short of explaining why the Adirondack Iron Company developed.

Although the exploring party did not find the silver mine, the iron ore discovery did offer new vistas for exploration. Henderson wrote to Mrs. McIntyre in that long letter,

> It would not benefit the Elba works - no chance of a road, but the vein lies on a stream where forges can be erected for thirty miles below it. No ore bed has yet been discovered on that side (near Elba). Shew'd specimens of the ore to some bloomers - they said there was no doubt about it.[11]

Significantly, the scheme for developing an iron works at this site was born immediately upon the discovery of the ore.

But events moved very slowly over the next several years. When the exploration party left North Elba for Albany, taking Lewis Elija, the Indian, with them so he could not show the land to anyone else, the first task was to secure title to the land. But as Archibald McIntyre wrote to Duncan McMartin, this process could last over a year. First, the Land Office had to order a survey and appraisal before an order to law could come through. McIntyre added, "There will be a necessity of great caution and secrecy in the meantime."[12]

But for matters of this nature, affairs moved fairly quickly, and by June, 1827, McIntyre was writing to McMartin to see if Judge John Richards had been hired to do the surveying. McMartin apparently was taking lead in all these activities, for McIntyre asked about "your ore lands."[13] Only 13 months after the discovery, McMartin wrote his wife that, "Judge Richards made his returns last week and he gives in them a tremendous account of the Rocky Mountainous Block he surveyed for D. Henderson and others . . ."[14] indicating that nearly all was ready for actually granting the patent.

Then the pace slowed, for unknown reasons. Judge McMartin, in his capacity as legislator, did succeed in getting a bill through the state legislature in 1829 that carried a $6,000 grant for a road from Lake Champlain through Essex County, and eventually to the Black River. McIntyre visited the site in April, 1828, but not until 1839 were there major signs of life. Perhaps the breathless arrival in Albany of 2 men with an Indian guide ready to claim the ore bed, spurred the owners on.[15]

Whatever the reasons, in early August, 1830, Henderson, McMartin, McIntyre, John Steele - a New York City machinist, called a chemist and metallurgist by McMartin - and 2 or 3 others arrived at the site, complete with blasting tools. During this visit, the partners developed the first serious plans for an iron works. A memo prepared by McIntyre costed out the expense of making charcoal at $2.85 per 100 bushels, using 25 cords of wood to make 1000 bushels. A local resident, P. R. Taylor, received a contract to furnish the charcoal in 1831 for a forge. The same Taylor was apparently to build a road into the site, and take over another contract to clear 5 acres.[16]

But the key problem that ran like a litany through the next 100 years of letters had already surfaced and began to hex the plans of the proprietors. Obviously, transportation held the key to the work's success. Located more than 40 miles west of Crown Point, over 120 miles north of Albany, movement of supplies and ore or iron proved exceedingly difficult. Duncan McMartin discovered just how difficult transportation could be in January, 1831. He attempted to move 6 tons of ore out to the state road from Cedar Point (Crown Point), for eventual haulage to Moriah on Lake Champlain. But heavy snow frustrated him, forcing a return to the settlement for provisions.[17] Over the years, McMartin's frustrations were experienced repeatedly.

The initial response of the proprietors to this primary obstacle also established a pattern later repreated many times. McIntyre wrote to McMartin saying there was talk in the legislature of developing slack water navigation on the Sacandaga River and on the northern branches of the Hudson. Enthusiastically, McIntyre urged his legislative partner to get involved in those discussions, and perhaps draw up a memorial. "If the Legislature will direct this to be done, and at the same time order a survey and estimate of the expense of making slack water navigation from Lake Pleasant on the one branch, and from the new state road on the other branch, or rather from

Lake Henderson on that branch, it would be just the thing for us."[18] The optimistic, even visionary quality of the Boorstinian "booster" is readily apparent about such a scheme, which called for taming long stretches of white-water river in an unpeopled wilderness. But no more realistic was the plan McIntyre submitted for McMartin's consideration a year later. McIntyre proposed applying for a charter to link the St. Lawrence River to the Champlain Canal, by way of the works, using railroad, canal, or slack water navigation, or all three combined. McIntyre even thought of hiring an engineer to survey the Hudson River for a slack water navigation to the works.

He was still pushing this idea in late 1832, as he pondered the transportation problem.

> Has not the State abundant inducement to improve the navigation of the Hudson from the Champlain Canal to out works? Will not such an improvement either by Canal & Inclined Plains, or by dams, locks & inclined plains pay a good interest?
>
> This will be the only thing that can make our property valuable, and this would do it effectively. We must devote all our energies to this object.[19]

McIntyre clearly was right that without access to the works, the property had little value. But to his rhetorical questions, common sense had to answer no. Not withstanding these adversities, such schemes for solving the transportation difficulties proved as constant a feature of the works as the difficulties themselves.

The early efforts at opening the ore beds presented other occurrences that served as pre-cursors and hints of constant problems that later dogged the works. One continual difficulty involved labor - not so much in finding an adequate supply as in finding workers who did a satisfactory job for less than extravagant wages, or even did the work at all. This pattern quickly became established, after McMartin reported upon his arrival in January, 1831, that Taylor's jobs of road-building and clearing were poorly done. Yet McIntyre answered that Taylor was still trying to get more money for that work.[20] Such complaints never ceased during the entire 25-year history of the iron works.

The other problems that surfaced early involved the actual difficulties in working the ore. The first hint of trouble came in tests conducted by John Steele apparently in New York City, and apparently using the ore so laboriously removed by McMartin in February, 1831. McMartin had apparently tested some of the ore himself with satisfactory results, but Steele obtained very different results. Different fluxes must have caused the discrepancy, McIntyre posited, or perhaps it was atmospheric weathering of the ore. Steele did get a very tough and malleable iron, and in one case even produced a sample like cast steel. Tools made from the sample were very good, but Henderson could not melt the iron in a pottery kiln. The discrepancy in these tests seems to have given the owners pause, and they gave up any plans to erect the works during 1831, electing only to blast out a quantity of ore to ship south during the winter, and to clear land for roads and settlement.[21]

The actual development of works began in May, 1832. McMartin planned to spend the whole year supervising the construction of the works. John Steele went north to actually run the forge, with the apparent intention of remaining as the company's agent when successful. Very high water, wet ground, and snow caused initial hardship and difficulties. Then as the snow ended and late May arrived, so did the black flies. These enormously pesky, but very small, biting flies made it almost impossible to keep workers. McMartin noted that only 2 or 3 men stayed at the works during the fly season.[22] He described the black flies as ". . . extraordinary troublesome for several days before I left and 4 or 5 hands cleared out in consequence. Some swell in large lumps where they bite them. Arch d. was in blotches and J. Steele; but we are informed that they will not last much past the 1st of July. The gnats are also considerably, but mosquitoes not so much so as in the woods there."[23]

The work proceeded quickly enough under the circumstances. The early efforts involved merely clearing land and moving in supplies. A 20x40-foot log house of 2 stories was begun, complete with glass windows. McMartin considered a farm to be a top priority, and had men planting potatoes, oats, and grass. A sawmill also ranked high, and McIntyre suggested a grist mill. The parallel with North Elba was already evident. McMartin also travelled to Schroon to see a millwright; and interviewed another with 2 carpenters at Smith's inn near Schroon. McMartin hired the latter to build the sawmill, a man named Spring and his partner Willard. These preparations - shelter, food, and materials had to be accomplished before the iron works were started. But in June, McMartin sent to North Elba for 2 or 3 wagon loads of iron and castings from the then-defunct forge there.

By mid-October, the initial structures stood almost complete: a working sawmill, log house, some stabling, coal house, forge for a hammer and two fires, and a blacksmith shop. The labor of McMartin and his force came to about $2000.[24] McMartin named the place McIntyre.

The very last structure completed was the forge itself - finished on 5 November, well after the owners had arrived to witness the test. The forge erected must have been a Catalan forge, little different from those developed in Europe during the 13th century.[25] By the early 1800s, as Frederick Overman observed, "The form of this fire is nearly uniform everywhere." In one corner of the hearth, a level stonework platform approximately 6 to 8 feet square, was a depression for the fire place, about 2 feet square and up to 20 inches deep. A skilled operator, called the bloomer, made iron in the fireplace, which was lined with cast iron plates. There a tuyere, or nozzle, blew air into the material for melting.

A chimney formed the back wall of the forge, and a roof usually covered the hearth. Charcoal was the fuel used, and up to 400 pounds of stamped, and usually roasted, iron ore was heaped in a mixture with the fuel. The charcoal provided both the heat and carbon necessary to reduce the ore and melt the iron into a pasty ball, or loup, that formed in the fireplace. Once the majority of iron had been extracted from the ore, this loup was worked under a tilt hammer, in a process called shingling, to remove cinder. The final product was a bloom of wrought iron.[26]

A modification of the Catalan forge, known as the German forge to Overman, but labelled the American Bloomary by Egleston, called for the use of hot blast pipes located in the chimney to heat the blast of air before it reached the fire-place. This particular forge process had developed largely in New Jersey and New York before 1850, from German antecedants, but became a special feature of the Champlain region. The American Bloomary process reached its highest development in the Adirondacks, and survived into the 1890s as a satisfactory process.

The Elba Iron Works had consisted of a simple Catalan forge in 1810, but the large battery of the modified forges that operated at Lyon Mountain on the Chatageauy ore bed until the end of the century continued to use much the same process.[27] In the United States, the American Bloomary process could almost be considered a regional Adirondack style that developed because of the inhibitions the lack of transportation placed on large scale iron operation. Its small size and fuel consumption limited the transportation difficulties involved in moving iron to markets. The long survival indicated the process was well suited to the Adirondacks.

The forge process had one major drawback - the inability to achieve a consistently uniform product. As Overman observed, "In the working of such fires, much depends on the skill and experience of the workman."[28] A good bloomer was a welcome asset to any forge. Moreover, only rich ores worked well. North Elba had not been so blessed, but many other Adirondack sites were, the most noted of which was the Au Sable River in the town of Wilmington. So when McMartin and company built their forge in 1832, they operated in the most accepted manner for the time and place. Initial capital outlay was not high; in fact, the other structures at the settlement probably cost more and took longer to build. But good forge iron was very good material. With high hopes, then, another Adirondack iron works was launched.

On November 8, the owners directed their bloomer, a man named Ferguson, to fire up the forge for the first time. Only three days before, Steele and 2 millwrights had finally finished it. By that afternoon Ferguson had drawn the first loup, but he had difficulty getting it out of the forge. Then it broke under the hammer. But Ferguson did succeed in drawing one section of the bloom out into bar, which John Steele pronounced steel. A second loup was made by 10:30 that night, and drawn into bars the next morning. These proved to be iron of good quality. Two other loups followed, one a mixture of the ores from 2 different locations that produced a mass of glass, and another of the first ore, called the rich ore, that worked into good iron. Then with Lake Sanford freezing over, they closed the forge.[29]

These tests demonstrated the difficulties experienced in working iron in a forge, especially the maddening problem of consistency. But they also started the owners thinking about steel, for the first loup had resembled the steel produced in a similar direct conversion process used by the Germans, a steel noted for its durability. As McIntyre wrote in his Memorandum following this visit, "Can the fire be so managed as that this ore will produce steel, like the German?"[30] For the next 20 years and more, this question would engage the interests and resources of the owners. It must be remembered that at this time only imported steel, primarily English, was available in the United States. Moreover, the McIntyre party was not the only group that embarked on the quest to produce steel in America. But they pursued it with remarkable tenacity.

Other interesting points emerged in the approach of the owners to the difficulties in establishing their works that, like the transportation and smelting difficulties, ran through the history of their efforts in an unbroken line. One significant point was the scientific frame of mind that always showed itself in their efforts to work the ore. From the start, John Steele of New York, whom McMartin called a chemist and metallurigist, had a place in their councils. One might question the applicability of these titles, for Steele only ran a machine shop in Manhattan through the 1830s and 1840s.[31] But McIntyre reported that in April, before Steele left for the works, the machinist was reading anything he could find on iron making. McIntyre also supplied McMartin with appropriate reading material, by sending the Judge copies of Cleveland's 2-volume Mineralogy, Bakewell's Geology and Eaton's book on the same topic.[32]

More important in the way of scientific approach was the contact McIntyre established with some of the most noted chemists and metallurgists of the day. This willingness to invoke the opinion of experts may in part reflect the Scottish upbringing of the owners, for the University of Edinburgh was the center at this time for descriptive medicine and the study of natural philosophy. Although McIntyre and McMartin could not have enjoyed the benefit of a primary school education in Scotland, Henderson almost certainly was educated there. Perhaps the noted school system there rubbed off on Henderson. When one remembers another famous Scotsman - Andrew Carnegie - and his celebrated comment that a scientist had no place in his steel works, the significance of the scientific outlook shown by the owners became apparent. Their's was a rather early effort to apply scientific analysis to the then empirical business of iron making.

By December, 1832, McIntyre was in touch with Dr. Lewis Feuchtwanger on the question of the German method of producing steel. Feuchtwanger, a German immigrant, had published an article in Silliman's American Journal of Science and the Arts on arsenic and its chemical reactions in 1831, which may have attracted McIntyre. His major work was published in 1838, A Treatise on Gems; in reference to their practical and scientific value. He listed himself that year as a "chemist and mineralogist, Member of the New York Lyceum of Natural History, and of the Mineralogical Societies of Jena, Allenburg, etc., etc.," Feuchtwanger owned a store in New York City where he sold German cutlery, silver and chemicals.[33]

By April of 1832, Feuchtwanger and another German had analyzed ore samples for the owners, determining that it contained 70% protoxide of iron, and 10% chrome. The chrome would necessitate the use of more lime to make slag, but "the ore is extraordinarily rich; well calculated to make steel."[34] By this time, the general location of the major ore bodies at the works had been determined, and samples of all were sent to Feuchtwanger.[35] Those ores on the west side of the river were called the Millpond Ores; those east of the river were the Black coarse-grained ores. On the east side of Lake Sanford, the owners discovered a huge ore body, called the Lake Sanford ores, while 3 or 4 miles west of Lake Sanford were the Cheney ores. By June, McIntyre had Feuchtwanger's report which called the Sanford ores very refractory, or hard to smelt. Moreover, Feuchtwanger made the first mention of titanium, an element that played a major role in the later story of these works. McIntyre wrote to McMartin about this discovery that the ore had ". . .a considerable quantity of Titanium in it, and that it can only be reduced in a furnace, and with much lime as a flux, erc. Even that at the forge he thinks to be refractory."[36]

Feuchtwanger was the first in a line of chemists whom the owners consulted about their ores. Just how valuable the advice was is debatable. To a certain extent, the chemical explorations provided mental gymnastics for the owners because the bloomers would have understood little of Feuchtwanger's analysis. Only when McIntyre received specific suggestions on techniques, such as instructions that accompanied Feuchtwanger's report to use more lime flux, did the efforts of the chemists have any impact on operations. The chemical studies seem to have been more important in guiding the owners' decisions about large-scale improvements and additions to the works than in determining the shape of day-to-day activity at the forge. More importantly, an awareness of new trends and discoveries in chemistry and metallurgy was directly coupled with an awareness of changes and developments in iron technology. Most treatises on metallurgy of the time included long chapters on how to make iron in the most up-to-date manner. Although not all the technical features at the works were state-of-the art installations, the owners were definitely aware of the rapid changes beginning to take place in iron smelting technology. By and large, the works showed signs of this awareness.

The final thread that appeared at the beginning of the work's history and was woven through the whole fabric of the story was the owners' hopes and dreams for their property. As in so many speculative ventures, the partners rode an emotional roller coaster. The important factor was the near-constant belief that their property possessed some special quality guaranteeing success. As McIntyre wrote early in 1832, "It is agreed by all that we have a field for extension and vast operations, and that probably at some time or other works of great magnitude will be erected or carried on at our place."[37] But the numerous difficulties countered that optimism at times, as was evident in this letter to McMartin. "Our

Northern concern is a heavy one, and I particularily regret that until we get into an entirely different way, it must of necessity command your almost exclusive attention, and compel you to be the most of your time away from your family. This is hard, very hard, but there seems to be no alternative . . ."[38] Yet the optimism was there, constantly buoying their spirits. "You have had very hard struggling this season in the woods - but if we go on, I think, it will be easier the next, and every following season."[39]

Their ultimate goal was the product of this same enthusiasm. Their aim was first to prove the value of the property by showing that they could make iron of good quality. Having performed this demonstration, they planned then to sell out to a company or a group of capitalists - clearly meaning English investors - who could develop the works with better financial resources.[40] The land speculator is glimpsed here, but the later history of the place puts the lie to the get-rich-quick motivation implied by this goal. As it worked out, the proof was too long in coming for this dream to be realized. Henderson had written in 1826, "This enormous iron bed kept possession of our minds - I dreamt about it - "[41] One could imagine a cartoon character's eyes ringing up dollar signs as he contemplated this ore bed. From the start, however, one feels that although their dreams of making a fortune are constantly in the background, the biggest attraction of the place was the challenge of exploiting it. The difficulties were always present - but that was part of the game.

# FOOTNOTES

1. Henry Jarvis Raymond, New York Daily Times, 19 June, 1855; in Harold Hochschild, "Addendum to Chapter 13," 1953, for Township 34, (Syracuse, N.Y., 1953) p. 170 A.

2. William B. Sprague, D.D., "Sermon occasioned by the death of Archibald McIntyre," Sunday afternoon, 9 April, 1858, 2nd Presbyterian Congregation, Albany, (Albany, 1858), in Adirondack Museum Library, Blue Mountain Lake, N.Y., Box 3, Folder 18; and "New York State's Comptrollers: 50 Guardians of the Public Purse," Published for the New York World's Fair, 1964-65, in Adirondack Museum Library, Ibid. Hereafter all material from the Adirondack Museum Library will be referred to only by individual item, accession number, box and folder.

3. See L.W. Watkins, "Henderson of Jersey City and his Pitchers," Antiques, December, 1946, pp. 388-92; and Arthur Masten, The Story of Adirondac (Syracuse, 1968) p. 18. Hereafter referred to as Masten, (1968).

4. MS 61-62, Box 2, Folder 9, Correspondence between Duncan McMartin and Archibald McIntyre; also Masten, (1968), p. 13.

5. Archibald McIntyre to Duncan McMartin, 16 June, 1813; 13 September, 1817, 8 July, 1818, MS 61-62, Folder 9; Masten, (1968), p. 15.

6. Harriet Phillips Eaton, Jersey City and its Historic Sites, (Jersey City, 1899), p. 74; Archibald McIntyre to Duncan McMartin, 13 January, 1827; MS 61-62, Box 2, Folder 9; 6 January 1834. MS 61-62, Box 3, Folder 11A. The lottery in Delaware was for the Delaware College, authorized by Act 362 of the State Assembly in 1837, but declared unconstitutional in 1843. D.S. Gregory in whose name the Delaware legislature acted, later owned the steel works in Jersey City and served as one of the trustees of Henderson's estate for his children. See Laws of the State of Delaware, Volume VIII, (Dover, 1837), pp. 355-7; Volume IX, p. 561; James McIntyre to James R. Thompson, 9 December, 1858, MS 65-28, Box 5, Folder 20.

7. The Placid Pioneer, Lake Placid-North Elba Historical Society, Autumn, 1969, pp. 5-12; Paul Jamieson, The Adirondack Reader, (New York, 1964); Francis L. Bayle, "History of the Tahawus Region," High Spots, Volume 9, July, 1932, pp. 11-15; Masten, (1968), pp. 18-27; Original in Adirondack Museum Library, David Henderson to Mrs. McIntyre, 14 October, 1826, MS 74-18, Box 1 Folder 10. Following information is drawn from that letter.

8. Nathaniel Bartlett Sylvester, Historical Sketches of Northern New York, (Troy, 1877), p. 136. The North Elba Town Historian, Mrs. Mary MacKenzie, was most cooperative in allowing the author to read her unpublished manuscript, "The History of North Elba," which contains a history of the Elba Iron Works. Her more-detailed research knit together the isolated information about this company. She dated the firm's start to 1811.

9. Ibid; Iddo Osgoos to Roland (Robert?) Clark(e?), 8 November, 1852, MS 61-62, Box 1, Folder 12; James McIntyre to John Ely, 1 November, 1823; Property valuation by John F. Chernfiln (?) and Issac Finch, not on cover 1810 or 1811, MS 65-27, Box 35, Elba Packet.

10. "The Famous Letter From Elba," Lake Placid Pioneer, Mary MacKenzie, ed., Lake Placid-North Elba Historical Society, Autumn, 1969, p. 5.

11. Henderson to McIntyre, 14 October, 1826, MS 74-18, Box 1, Folder 10.

12. Archibald McIntyre to Duncan McMartin, 11 November, 1826, MS 61-62, Box 2, Folder 9.

13. Ibid., 8 June, 1827. McIntyre may not have actually been financially involved ". . . in the mammoth ore bed speculation in Essex . . ." until December, 1828, when he bought Malcolm McMartin's share - Duncan's brother. McIntyre to Duncan McMartin, 27 January, 1829, MS 61-62, Box 2, Folder 10; See also Ibid., 24 December, 1828, MS61-62, Box 2, Folder 9.

14. Duncan McMartin to Margaret McMartin, 12 November, 1827, MS 61-62, Box 2, Folder 7.

15. Ibid., 29 March, 1829; Archibald McIntyre to Duncan McMartin, 29 April, 1828, MS 61-62, Box 2, Folder 9; David Henderson to McIntyre, 15 July, 1830, MS 61-62, Box 2, Folder 8.

16. Duncan McMartin to Margaret McMartin, 7 July, 1830, MS 61-62, Box 2, Folder 7; Archibald McIntyre to Duncan McMartin, 5 August, 1830, MS 61-62, Box 3, Folder 10; Iddo Osgood to Roland Clark, 8 November, 1852, MS 61-62, Box 3, Folder 12; MS 65-28, Box 6, McIntyre to McMartin, 17 December, 1830, MS 61-62, Box 2, Folder 10.

17. Archibald McIntyre to Duncan McMartin, 14 February, 1831, MS 61-62, Box 2, Folder 10.

18. Ibid., 25 December, 1830.

19. Ibid., 10 December, 1831; 30 July, 1832; McIntyre Memorandum on Essex County Memmoth Ore Bed, 2 November, 1832, MS 65-28, Box 6.

20. Ibid., 14 February, 1831. In June, McIntyre asked McMartin to find someone else to build a road, for Taylor was not to be hired again. Ibid., 21 June, 1831.

21. Ibid., 1 March, 1831, 21 June, 1831; 22 June, 1831; 6 July, 1831; 3 August, 1831.

22. Ibid., 3 January, 1832; Duncan McMartin to Margaret McMartin, 11 April, 1832; 27 May, 1832; 28 June, 1832; MS 61-62, Box 2, Folder 7.

23. Duncan McMartin to Margaret McMartin, 27, June, 1832, MS 61-62, Box 2, Folder 7.

24. Duncan McMartin to Margaret McMartin, 28 June, 1832, MS 61-62; Box 2, Folder 7; Archibald McIntyre to Duncan McMartin, 4 July, 1832; MS 61-62, Box 2, Folder 10; McIntyre Memoranda on Essex County Mammoth Ore Bed, 24 October, 1832, MS 65-28, Box 6; McIntyre to McMartin, 12 October, 1832, MS 61-62, Box 2, Folder 10.

25. Information on the Catalan forge is drawn from Frederick Overman, The Manufacture of Iron in all its Various Branches, (Philadelphia, 1850), pp. 245-9; John Percy, Metallurgy, (London, 1864), pp. 278-315; T. Egleston, "The American Bloomary Process for Making Iron Direct from the Ore," Transactions of the American Institute of Mining Engineers, 8 (1880): 515-550, plus plates; James M. Swank, History of the Manufacture of Iron in All Ages, (Philadelphia, 1884), p. 61.

26. This was the exact process performed by the company, as described by Walter R. Johnson, "Experiments on Two Varieties of Iron, Manufactured form the Magnetic Ores of the Adirondack Iron Works, Essex County, N.Y." American Journal of Science and the Arts, 36 (July, 1839): 95.

27. See J.R. Linney, "A Century and a Half of Development Behind the Adirondack Iron Mining Industry," Mining and Metallurgy, November 11, 1943, pp. 481-4.

28. Overman, (1850), p. 247.

29. McIntyre Memoranda on Essex County Mammoth Ore Bed, 8 and 9 November, 1832, MS 65-28, Box 6.

30. Ibid., 9 November, 1832.

31. J. Disturnell, A Gazetteer of the State of New York, (Albany, 1842).

32. Archibald McIntyre to Duncan McMartin, 25 April, 1832, MS 61-62, Box 2, Folder 10.

33. Lewis Feuchtwanger, "Arsenic and its Chemical Reactions," American Journal of Science and the Arts, XIX (1831); 268-72; American Library Association, Resources and Technical Services Division, the National Union Catalog, Pre-1956 Imprints, (London, 1971), 171: 214-5; Lewis Feuchtwanger, A Treatise on Gems, (New York, 1838), Title Page: McIntyre to McMartin, 14 May, 1832, MS 61-62, Box 2, Folder 10.

34. Ibid; 3 December 1832; 13 April, 1833; 26 April, 1833.

35. See map on Title Sheet of HAER Survey Drawings for these locations.

36. Archibald McIntyre to Duncan McMartin, 26 April, 1833; 6 June, 1833; MS 61-62, Box 2, Folder 10.

37. Ibid, 3 January, 1832.

38. Ibid., 1 December, 1832.

39. Archibald McIntyre to Duncan McMartin, 9 October, 1832, MS 61-62, Box 2, Folder 10.

40. *Ibid.*, 3 December, 1832.

41. David Henderson to Mrs. McIntyre, 14 October, 1826, MS 74-18, Box 1, Folder 10.

# CHAPTER II

The next few years of the operation were perhaps the most difficult for the owners, not because of expenses, but because of the delays and seemingly interminable problems. An annual tempo of activity developed that, as with so many other features, quickly evolved into a pattern. The first yearly step was to assess the needs of the works and lay out the guidelines for the next year's push. McIntyre and Henderson developed an extensive list for 1833's activities, including:

1. Construction of a dam on Lake Henderson to furnish more water to the works.
2. Clearing land for cultivation.
3. Building a road from the works to the state road.
4. Erecting of a store with a counting room and bedrooms.
5. Surveying a route for a road east to Clear Pond.
6. Having 2 men blasting ore all season.
7. Redoing the boarding house to add a kitchen and cellar.
8. Keeping the sawmill at work.
9. Clearing earth off the entire ore bed.
10. Building a good road up the Main Street; also one from the ore bed to the forge; and a bridge over the river to start a road over to the East Hill for lumber and charcoal.
11. Getting a sufficient number of bloomers to work the whole season.
12. Purchasing additional land, including state land east of the works and the Newcomb farm south west of the settlement.
13. Inquiring about the use of Doolittle's patent for charcoal manufacturing.[1]

As the plans for the year unfolded, the necessary supplies had to be purchased and then shipped via Sleight (from Albany) to the works. This means of conveyance was the only transportation possibility that made sense, for the muddy spring or early summer roads were almost impassable. Snow and ice offered a better medium on which to move the bulky food stuffs and heavy construction supplies. A yearly trauma quickly developed about getting the material into the settlement before the snow melted. McIntyre constantly worried about this problem. "I presume that whenever the sleighing will permit, you will start teams to the North with provisions, etc. It is so important that everything of this sort should be done when out works are accessible with loads."[2]

Inevitably, there were major delays in the delivery of material to the works, either through difficulties with teamsters, or because of thaws that ruined the sledding. McIntyre fretted at such delays - he appears to have been the most prone to despair about the works - and got very upset at the immense problems he saw confronting the owners.

> It really looks appalling and I cannot help occasionally looking on the whole matter with dread, and to repent that we ever went on with the business. With the greatest care and economy, to get business started there, and roads (passable roads) made, will require the expenditure of large sums of money. That I would not, however, regard should I be able to meet them, which I hope I may be able to do without inconvenience - but then the dangers and hardship which must be endured before anything is effected, are really frightful.

Yet as usually happended, McIntyre did not reach the point of throwing in the towel. "But notwithstanding all these appalling difficulties, if you think it advisable to go on and encounter them all, I shall not object."[3] Clearly, though, McIntyre had lost his initial enthusiasm once the effort required to exploit the iron became clear.

This discouraging tone ran through most of McIntyre's letters for 1833 and 1834, with good reason. The former year did see a great deal accomplished. A chimney and enlargement went up on the boarding house, and new roads soon stretched around the settlement. Land was cleared of trees all the way to Lake Henderson, and also south of the house. The crops planted included potatoes, hay, and grass. Of the oats on the east side of the river, Henderson remarked, "I have not seen so fine a crop of oats in these United States . . . ." By September, 30 men, 5 women and a child were at the works, now named McIntyre.[4]

Unfortunately, the making of iron continued to be plagued with problems. First, the owners had to arrange for bloomers to run the forge. A letter to McMartin noted, "It is to be hoped you will be able to engage sensible bloomers to try our ore, and that they may soon be able to test its value. I cannot help occasionally having some fears and misgivings about final results. But it is folly to indulge in croaking now - We must push on."[5] Everything McIntyre wrote in 1833 exhibited the same ambivalence. But he seemed to reach a low point when McMartin found that the blowing cylinders made by Steele had used unseasoned wood and leaked. McMartin purchased a new set in Keesville for $180. But not until late fall did the new bellows arrive, thus hampering operations all year. The forge required some major alterations in other respects as well, for McMartin also brought in 4109 pounds of casting made at Port Henry. With the new bellows came a millwright to reposition the water wheel powering the blowers.[6]

These delays reduced McIntyre to despair.

> I confess that I am at times alarmed and disheartened with this same concern of ours, and afraid that it may turn out another Elba concern. I cannot allow myself to believe it will be so, and yet I cannot avoid something of having my fears. For, the ore has not yet been tested - the roads are abominable,

> and the coal wood in the vicinity very scarce. Had I seen my Lycoming lands before we laid out so much money at McIntyre, I should have advised to let the northern lands lie still and got you engaged at Lycoming, where there is an inexhaustible quantity of the finest iron ore for the furnace, and equally inexhaustible quantities of the finest bituminous coal for converting ore into pigs and bar iron on the spot.[7]

McIntyre also feared that some other entrepreneur might beat him to opening his coal and iron lands in Pennsylvania. His perception as to the ultimate impact of coal-smelted iron on the charcoal iron industry was also correct. The only alternative McIntyre considered was to sell to owners able to finance the works.

> Should capitalists in Pennsylvania get in the way of making large quantities of iron with bituminous coal, then those who make from charcoal can never compete with them - and that this will be done before very long, I have no doubt. A company of rich Bostonians are getting out large quantities of coal on the Susquehanna, and are monopolizing all the coal and iron lands they can get, and making preparations for carrying on the Iron business extensively . . .We must strive to get our works in a condition for a company to be encouraged to purchase them, and sell them if we can. Let them be ever so profitable, they will be too heavy for us to carry them on an extensive scale, so as to make them profitable. To make a road, such as there ought to be to carry the Iron to the Lake, would cost a heavy sum, whether on the route you are to explore, or to repair the old one. And as for a slack water navigation it cannot be thought of by us until we get capitalists to join us.

The biggest setback was the inability to adequately test how the ore worked. Not until mid-November were the new blowing tubs ready for testing. McIntyre hoped these experiments could determine their next course of action.

> If upon trial the ore works well, that good iron shall continue to be made of it - that it will require but an ordinary quantity of coal, and that the Iron can be made with the usual despatch, we shall be encouraged to proceed and do something more in extending the works, etc. But, if iron cannot be made with a decided and certain profit in that wilderness, we had better be very cautious how we throw away any more labor or money upon the business.

> I trust that before you leave for home, you will have made a fair trial of the working of the ore, and enable yourself and us to form a judgement of what we had best to do - whether to proceed or stop short. I pray that we may never be obliged to adopt the latter alternative.[9]

Yet while McIntyre felt very unsure of the partners' prospects, he could at the same time show himself quite unwilling to give up their enterprise. At one point in July, the pessimistic McIntyre had to reassure an equally discouraged McMartin. "The experimenting may be expensive and tedious - but we have no alternative but to persevere until we succeed."[10]

The actions of the 3 principals often belied the despair evident in their letters. Throughout the year McIntyre urged the acquisition of more land, both to provide charcoal for larger works, if ever built, and to permit construction of a dam on the North (Hudson) River near the state road. Not only did they have the forge and bellows repaired, but the owners also planned to purchase a magnetic separator from the builder in Keesville. Another separator at the Palmer ore bed, closer to Lake Champlain, worked very well. Henderson felt one with a 3-ton daily capacity would serve. The bloomer liked the machine, which accepted 70% of the ore. A test of the remains with nitric and nitro-muriatic acids - the usual tests for iron - found the samples insoluble, an indication of no iron.[11] Concerns contemplating going out of business rarely consider such purchases, either of land or machinery.

The fascinating part about the outlook of the owners was the suddenness with which they could shift from despair to hope at their prospects. Often within the same letter, both extremes of emotion could be found in close proximity. McIntyre wrote to McMartin in November, 1833, "Had you or I supposed that we would have had to encounter one half of what we have, and for the expense and labor have made no greater advance in works and improvements, we certainly would not have meddled with it." Yet in the very next paragraph, McIntyre began to discuss the plans for getting the next year's supplies in.[12]

The interplay of emotion for 1833 ended with the determination to continue, for the potential of the works seemed obvious to all, and muted enthusiasm carried the proprietors on.

> . . . There is little doubt but the whole valley and sides of the mountains are masses of iron. - However inadvisable it may be for us, under existing circumstances, to drive this business to any extent, I am for one much disinclined to a sale of the property unless indeed to a company, who might afford to give something adequate to its value. Where can such a place be found?

> (And) . . . should anything like Carron or the Welch works of Merther-tydal (sic) ever be erected there - it is well to know that an enormous water power can be readily created, at a trifling expense.[13]

Tempered by the difficulties they faced, the dreams of grandeur still remained alive, for Merther-tydal was the largest Welsch iron works. The primary impetus to continue was indeed the vast amount of iron ore. Moreover, when the forge worked well, the iron appeared to be of excellent quality. Forbes, the third bloomer of 1833, worked the ore from the original bed with good success.

> The iron it makes is extraordinary for its toughness, and the only drawback is a propensity to scale. This, the bloomer thinks is for the want of a regular blast, which he cannot get with the present bellows - there is not the least red-sheer about it - the first loup he made of that ore was excellent and very fine grained <u>steel</u> but could not work it under the forge hammer. - he has since, however, had a loop, which he did draw out under the forge hammer into square bars, which proved to his astonishment to be steel . . . He wrought for iron as usual and could not account for it. I suppose it had more heat - the ore unquestionably unites with the carbon with great facility.[14]

The uncertainty of just what kind of iron they could make in large part led to the disillusionment of 1833, but the occasional successes were too enticing, so the partners continued.

Unfortunately, 1834 saw little improvement. The partners spent at least $3300 during 1833, $1500 for purchases, the remainder in wages. But the repaired equipment came into use so late in the year, that the owners chose to run two fires through the winter to determine just how the ore worked. Forbed experienced a small degree of success with the new blower, but the loops still crumbled and the bars scaled.[15]

The continued lack of success brought the three partners to a real dilemna. McIntyre was not sure what to do about ordering more supplies. But finally, they choose to go on.

> We have no additional information of the success or want of success in the trials for making iron than what you communicated - and the results which you sent us from Forbes were certainly not very encouraging. To expend more money, therefore for Provisions, or indeed for anything else at McIntyre, may be totally lost - and yet if upon further trials it should be found that Iron can be profitably produced, it will be a subject of regret and vexation to be retarded

> in necessary improvements for the want of provisions. Hence Mr. Henderson and myself, have come to the conclusion to advise your purchase of the additional Pork and flour, which you speak of, or any other quantity you may think it advisable to buy.[16]

In this hesitant way, the works carried on. In a similar manner, the owners decided to erect a dam across Lake Henderson, and to purchase additional land at tax delinquent sales. The consequences of not pushing forward would handicap the place if indeed Forbes met with success.[17]

Finally, there seemed to be a ray of hope. Daniel McMartin - Duncan's son - had taken charge of the works and in April, 1834, reported that Ferguson and Forbes, the bloomers, had achieved some success by using flint as a flux. As of mid-June, the younger McMartin wrote that only steel was being produced. Combined with a test report from John Steele that a 1/10-inch wire drawn from a McIntyre bar supported 550 pounds, the prospects suddenly seemed bright. McIntyre rejoiced, "The two Steeles are of the opinion that the Iron is of immense strength."[18]

The other additions to the works proceeded satisfactorily as well, with a store and frame dwelling going up, along with the dam. Ten acres of potatoes were in, also oats and turnips. Affairs seemed to fine shape, at long last, with Ferguson making 1500 pounds of iron a week by June. McMartin's other son wrote to his father, "He (Ferguson) makes iron of a superior quality to any made in the state, at least so it is pronounced to be by all who have yet tried it. But he cannot make it fast." The goal, then in sight, was a ton of iron a week. He had lost a couple of loups the week before, and the tuyere had slipped, or Ferguson would have reached that mark. Also, the McMartins expected another skilled bloomer to arrive very shortly.[19]

Then almost instantly, the bottom dropped out. In the 6 weeks between the near-success reported on June 23rd and the first of August, something happened to convince Daniel McMartin to give up all hopes of producing loups of sufficient size to pay. Henderson, writing to Duncan McMartin, sounded as perplexed as present-day readers, after the previous good reports of making steel, of increasing size of blooms, of low charcoal use, of strong iron. But whatever did happen, Henderson concurred in stopping the works and paying off the bloomers. Other hands were to go on making charcoal and mining and roasting the ore. Then 2 New Jersey bloomers could try the iron, and perhaps even a Swedish or Russian craftsman. Henderson added, "It will now be a work of experiment, and a systematic one . . . I cannot think of abandoning when so much labor and money has been spent. I do not despair of it's yet being found out - a proper way to make it."[20]

But while Henderson could endure going on, McIntyre had reached the end of his patience. After a short visit north in early September, the eldest of the owners penned this letter to McMartin.

> The more I think of our unfortunate concern, the more I am satisfied of the egregious folly of our whole proceedings, and of the necessity of making what can be made from the wreck as speedily as possible. I had thought, you know, of having a quantity of the Ore drawn to the Dalany furnace, in order to have it tried in that way - but it will only be making more expense without any satisfactory or profitable result. We are at least half a century too early in opening that region. I am of opinion that the sooner Daniel winds up the whole concern, and converts everything into money that can be converted, except simply, a pair of horses or a yoke of cattle for W. Yates, and such which as he may want - the better. I hope therefore you will instruct Daniel to do so as soon as may be. I am willing to be at some expense for a year or two, or even more years, to maintain W. Yates or some one like him at the works - but let us out of every other expense, and get back what little we can from the wreck.[21]

Such a final ultimatum, however, did not seal the fate of the works at McIntyre. Henderson wrote to McMartin only 2 weeks later that he, at least, was not sure about the decision to stop. Of the 3 available options - abandonment, temporary pause, or continuation, Henderson preferred the latter. McIntyre refused to advance any additional funds, so Henderson developed a scheme whereby John Steele would rent the works, with use of all materials, and get his own bloomer. Unfortunately, Steele, initially optimistic enough to believe that he could get the works to pay in 2 or 3 years - backed out and went to New Orleans instead.[22]

The works hit their low point in the fall of 1834, and remained there for a couple of years. Some 3 or 4 tons of iron required shipping out, but no new plans for a return emerged. With the exception of two bloomers in Fort Ann who proposed renting the works, a plan aborted by May, 1835, the works sat idle through 1835 and early 1836. A family remained at the farm and the owners considered expanding that operation, but basically the place was quiet.

This indecisive arrangement bothered McIntyre as much as the uncertainty over the iron production had. "It is mortifying in the extreme to be at a continual and considerable annual expense with it, when there is so little prospect of its ever becoming of any value to us. On the other hand I cannot endure the idea of abandoning a concern to destruction for which we have done so much and from which we (not very wisely, perhaps) anticipated much."[23]

McIntyre never resolved this impasse, for the above statement applied equally well to any year between 1832 and 1856. But in late-summer, 1836, some signs of life began to return to the works, although the purpose was more recreational than business. William C. Redfield, Abraham Van Santvoord, and David Colden accompanied McIntyre and Henderson north in August. Redfield by the 1830s had embarked on the scientific career that led to his election as first president of American Association for the Advancement of Science in 1843. His primary interests were meterology and geology. But through the 1830s, Redfield acted as one of the greatest boosters of steam navigation and railroads in the country. Redfield's interests in McIntyre were probably both commercial and scientific. The party found and named Avalanche Lake and Lake Colden, both located east of the works, and took some ore samples. The visitors spent nearly all their time in the mountains. But on their return, McIntyre wrote that Redfield and Van Santvoord ". . . seem fully inclined to take hold of our Iron concern and make the most of it for themselves and us." Henderson had even prepared some articles between them, while Redfield attempted to secure more land.[24]

No further mention of the Redfield scheme was made, however, although transportation improvements, either a railroad or slack water navigation were again discussed, at the instigation of a Mr. Richards - perhaps Judge Richards the surveyor.[25] But Redfield was back the next summer with another group of scientists, in yet another context.

The State of New York in 1836 authorized the establishment of a Geological Survey to run for 5 years, and Redfield had joined the team, headed by Ebenezer Emmons, charged with the survey of the 2nd district that covered Essex County. The resurrection of the iron works dates to the Geological Survey, for although formed for a scientific mission, most such surveys served as boosters societies for exploitation of natural resources. The key difficulty so many industrial ventures faced as they struggled into existence was attracting investors' recognition of their potential. The state surveys, by identifying promising mineral, timber, or agricultural features could and did highlight the value of given areas. But rarely did a state survey offer such substantial assistance to a private firm as Ebenezer Emmons provided to the struggling iron works of McMartin, McIntyre, and Henderson.

Emmons performed three vital services to the iron works owners. First, he made the first systematic survey of the various ore deposits and determined their extent. Emmons also made some rough determinations of the quality of the ores. More importantly, Emmons either sponsored, or at least arranged, a set of trials for the various ores by working in the forge. The geologist then arranged for a noted chemist to test the bars. The experiments worked very well, and the success proved to Emmons and the owners that the ores could be made to produce a high quality iron. Finally, Emmons publicized the extent of the ore beds and the quality of iron produced. Either Emmons or members of his staff spent part of every year from 1837 to 1841 at the works, and the iron works was mentioned in each of the 5 annual reports Emmons wrote as his part of survey's annual statement to the New York legislature.[26] Two reports were especially important for the amount of attention given to the works.

The first detailed report came in the 1838 report, of 1837's activities, which included working the ore at the forge. Emmons made 3 points about working the ore. First, drop stamps could easily reduce the ore to powder. Secondly, the ore contained no damaging impurities like sulphur or phosphorous. Finally, the ore could be reduced at a relatively low temperature, lower than any other Emmons had seen. He went on, "This is a matter of great consequence, when it is considered that in the interior of Essex the soft woods are the most abundant, and must be relied upon for the reduction of it. From trials which were made at McIntyre this last season, it was settled, conclusively, that the ore may be perfectly reduced with spruce coal alone, and that it possessed advantages over the coal of hardwood, independent of the facility of obtaining the former."[27] Emmons then went on to say the Essex County ore beds surpassed the recently discovered beds of Missouri in extent and favorable location relative to fuel.

While this report was positive enough, it was in the "Fourth Annual Report" in 1840 that Emmons was most enthusiastic about the works. After the 1837 tests, the bars made were sent to Professor Walter R. Johnson of Philadelphia. Emmons devoted most of his 1840 report to the works, and printed most of Johnson's report. Johnson ran a thorough battery of physical tests on the iron bars from McIntyre that showed the iron was neither cold-short nor hot-short, weaknesses caused by sulphur and phosphorous in the ore. Johnson also tested the strength of the bars in the machine developed at the Franklin Institute for testing boiler plate. The McIntyre samples proved stronger than any other iron tested, with the exception of a Russian iron bar, and an English cable bolt.[29]

McIntyre was quite pleased when he received this report. Over the next 15 years Johnson's tests and Emmon's report buoyed the hoped and dreams of the works' promoters. There was proof their ore and the iron it produced were special and unique in quality. Emmons said it outright in his report, "When it is considered, that this iron was not manufactured by the most approved process but rather in a rough unscientific method, it seems to be clearly established, that there is something very extraordianry in this ore, to produce the kind of iron which is proved by experiment it actually does."[30] Emmons went on to become an outright salesman for the works, advocating their immediate development.

> Iron is so much used in the present state of society, and so many lives depending on its quality, that it is a subject of great importance to secure for public use, that quality of iron, which shall not jeopardize life and limb in the public conveyance on the great thoroughfares of the nation. It is in this light, that an article becomes important to a nation, and though its patronage benefits in a pecuniary point of view, the individual proprietors, yet, the nation is after all the most benefited by promoting safety and expedition, on the ocean and on the land.[31]

The crucial chapter in Emmon's report was entitled, "Peculiar Advantage of the Village of McIntyre and its Vicinity for the Extensive Manufacture of Iron." Not only did Emmons point out the resources beneficial to an iron works, such as water power - he found 5 mill sites with a 13 to 15-foot head on the 2 miles of river between Lakes Henderson and Sanford - and nearby supplied of charcoal, clay, ore, and limestone. The state geologist also went on to forestall potential nay-sayers who would point out the peculiar disadvantages of the works. Two sections from this chapter indicate how far Emmon's boosterism extended.

> On a partial view of this subject, it might appear that a distance of 40 or 50 miles from water-carriage to the great markets, would be an important objection to an establishment which involves in its very nature the transportation of heavy articles. When we further consider, however, that such are the improvements in the construction of railroads and canals, and that scarcly any part of the country is inaccessible by the one or the other of these modes, the objection vanishes: and the only inquiry remaining is, whether the vicinity of the proposed establishment abounds in the necessary articles for its successful operation.[32]
>
> * * *
>
> If we compare the prospects of an establishment at this place, with others in this country which might be named, and are in successful operation, the former would appear to great advantage. If, for instance, there are inducements to embark in the manufacture of iron, where the ore costs at the mine $5 per ton, and which has to be transported over a rough country on wagons 4 and 5 miles, and in some instances 20; and at the same time charcoal cannot be obtained at a distance much short of 6 or 8 miles, I say, if under these circumstances, it is a profitable business, (and large dividends are realized,) what may not be expected where the ore cannot cost more than $1 per ton at the works, and an abundance of coal may be obtained in their immediate vicinity at $350 to $400 per 100 bushels. To these considerations must be added the superior iron which the ore produces.[33]

The Emmons reports perhaps represented the strongest contribution that McIntyre's scientific connections made to the enterprise. Not only did an outside expert with strong credentials highly recommend the iron produced here, but the expert's reports were stamped with the implicit approval of the State of New York. Most importantly, the report offered excellent publicity potential to the company. In 1840, Emmons reprinted his survey report, almost certainly with the proprietor's assistance, as a pamphlet called "Papers and Documents Relative to the iron ore veins, water power, and woodland, etc., in and around the village of McIntyre . . ." For the next 15 years, any prospectus or sales pamphlet continued to quote from the state geologist.[34]

Although the iron works were not successfully sold as McIntyre and the others had hoped, the various offers that croped up over the years probably owed something to the dissemination of Emmon's surveys. As the Disturnnell Gazetteer observed in 1842, "This place has lately been much celebrated, from the discovery in its immediate vicinity of a number of veins of extraordinary size and extent of the richest and purest magnetic oxide iron ores, as particularly described in the State Geological Reports."[35] The publicity value of Emmons's work should not be discarded. Intriguingly, all subsequent geological surveys, both private and state, have merely added to the base built by Emmons, who for his day and age, was amazingly accurate in his description and analysis of the ore deposits.

The contrast between activity at McIntyre before and after the release of Emmons's reports was startling. By late in 1838 the owners had determined to resume operations, and no wonder with the glowing reports they were getting about their property. The only difficulty was finding a man to supervise the works. With the death of Duncan McMartin in 1837, neither other owner could spare the time at the works.[36] To replace Judge McMartin, McIntyre, having purchased McMartin's share just prior to his death, permitted Archibald Robertson to buy that $20,000 share. Robertson, McIntyre's nephew, lived in Philadelphia, worked as a broker, and had married Henderson's sister.[37] But Robertson had neither the technical or managerial experience necessary. Instead, the owners hired Andrew Porteous as works manager.

Porteous's background is unknown, but the correspondence indicates he was hired as manager-clerk-payroll-and-personnel officer, and not as iron master. The years would change his role, but in 1838, his duty consisted of implementing his absentee employers's wishes and overseeing the iron-making under the bloomers's charge.

Porteous arrived about October, 1838, and immediately set the place running again, with the hopeful intention of working all winter. First, he tended to details, such as getting logs in for sawing into planks, and constructing a new kiln for roasting ore. The new manager also had to cope with break downs at the forge and the old magnetic separator. The separator and ore stamps stood in the forge, in close proximity to each other, and the jarring of the stamps knocked ore off the magnets. McIntyre and Porteous planned to erect a separate building for the stamping and separating operations to eliminate that problem. Finally winter brought the works to a halt, the inadequate stove in the wheel house could not prevent the wheel from icing up.[38]

This lull in the actual iron-making operations gave Porteous an opportunity to grapple with a number of other tasks. At the top of the list were supply problems, caused chiefly by a lack of transportation. Porteous made great efforts to achieve self-sufficiency at the works, and he emphasized more reliance on the two farms. He planned to raise hay and grass for the cattle and brought in 50 bushels of English oats. Moreover, arrangements for butchering and salting meat went forward, to eliminate the long haul from Albany. The usual food crops of potatoes, turnips, and peas were to feed the workers. To lower the quantity of sugar requirements, Porteous also arranged for the works to make its own maple syrup. He even planned to put the two farms into an informal competition to see which could raise the larger crops.

Despite these efforts, in the 6 months prior to May 27, 1839, the owners laid out $8,561.20 for the works, including $1,170 in bank notes for Porteous. Most of this went for supplies, from bedding and cutlery to molasses and tea, not to mention $1,050.25 for flour. In November, McIntyre had started 120 barrels of flour and 60 casks of pork on their way north via the Champlain Canal to Cedar Point (Crown Point). These two items served as the staple products for the works. Naturally, moving such a quantity of food created numerous headaches, as evidenced by the way the flour ended up frozen in somewhere between Albany and the works by mid-December.[39]

Porteous inherited a scheme to help ease this bottleneck, apparently started in late 1838. Henderson and McIntyre had decided to build a railroad at least as far as the state road from the works, via the East, or Opalescent River. The idea may have had its genesis in a letter from Henderson to his partner in March, 1837, which discussed a horse-powered railroad in Pennsylvania. There, horses hauled 2-ton capacity cars with cast wheels and wrought iron axles on wooden rails dovetailed into ties at 6-foot intervals. The plan cost $320 per mile.[40] What plan the partners finally chose is not clear, but it seems to have differed little from the Pennsylvania plan described by Henderson. Some sections had to be elevated on wooden piles, still visible across Lake Sally. On April 1, 1839, the state legislation chartered this effort as the Adirondack Railroad Company, listing Henderson, McIntyre, and Robertson as owners. The route was to run from the works to Clear Pond in the town of Moriah. The terms of the incorporation called for work to begin within one year and be complete in three. James Holt, the contractor, was at work by July when the formality of stock sales took place, with McIntyre giving Porteous shares in the company. But the work took longer to complete than expected and was not finished in 1839.[41]

Porteous also discovered the problems of handling a work force for absentee owners. First, there was the matter of wages. Ferguson, the bloomer wanted $25 per ton of iron, rather than wages as he had gotten before. But the going rate elsewhere was only $16. Not until June 12 did Ferguson settle for $16, when Emmons reported that $12 per ton was the usual pay in most places. That Porteous had something to learn became clear when he offered another bloomer $39 a month. McIntyre questioned this, saying, "How will you get on with Ferguson to whom you pay for less?"[42]

Other labor problems stemmed from the difficult position Porteous occupied. Harvey Holt, who worked for his brother, the railroad contractor, caused problems by paying a few favored hands more than others and refusing then to acknowledge Porteous's superiority of rank. Porteous ultimately prevailed, but only insubordinate conduct from one particular worker, whose uncle

McIntyre directed that Dibble, the offending worker, be fired. Porteous also had to deal with unsatisfactory farm help, which he eventually fired, and exorbitant demands for charcoal. Labor relations clearly kept Porteous busy.[43]

One problem, although not of a major one, was still indicative of the difficulties in developing factory discipline in this era of growing industrial establishments. This problem involved the other Holt brother, Harvey, who had charge of the railroad. McIntyre warned his manager, "I ought to mention that although Mr. Harvey Holt is a very steady man through the year, yet in the winter, if a favorable season occur, he always takes a moose hunt. Overlook that, however." Porteous could hardly have done otherwise, for Henderson himself had John Cheney, one of the most famous Adirondack hunting guides, trying to capture a live moose. McIntyre observed, "I cannot say that I shall much rejoice at Cheney's success in this matter. Securing and feeding a dozen cows and oxen would be less troublesome, and certainly much more profitable, than one moose. But as this seems to be much of a hobby with Mr. H. we must not grudge him his pleasure."[44]

Despite the interruptions, delays, and moose hunts, Porteous did keep things moving at the works. A millwright was engaged to put the forge in order, including a new building for the separator and stamps. The only question about the new installation concerned the power source - could the old bellows wheel run those machines, or would a new wheel be necessary? A number of new structures went up, including a wood house, kitchen, a new dwelling, milkhouse at the Newcomb farm, a large coal house, a new flume at the forge, and a pig sty with a potato washer. By May, the carpenters were cogging the stamper and completing what they called the water separator. A tub wheel was installed to power that new set-up. Other chores included the construction of a sled road to allow the shipment of Lake Sanford ore to the forge, and the blasting loose of 400 to 500 tons of that ore.[45]

The most significant difference between the revived operation of the works and the 1832-34 experience was the radical shift in tone. The doubt and uncertainty had disappeared, replaced by impatience at extorbitant wage demands or lazy workers. Also missing were complaints about making iron. Apparently, Ferguson had no major difficulties in actually making iron, although it took two attempts before he had any success with the Lake Sanford ore. Again, emphasis deserves to be placed on the importance of the bloomer's skill, for he used very little equipment to make iron in the forge. Ferguson had only the following tool complement to work with.

| | |
|---|---|
| 2 pairs of bellows | 1 battle axe |
| 9 pairs of tongs | 1 hack |
| 11 shovels | 2 chains |
| 2 crow bars | 1 hoe |
| 1 forge hammer | 1 wheel barrow |
| 2 firkins | 1 grind stone |
| 1 dye (die?) | 2 coal rakes |
| 6 coal baskets | 1 hood |
| 2 chisels | 1 lamp filter |

All of this was worth only $559.87 and the bellows accounted for $500. But with these simple instruments and a great deal of skill, as of July 1st Ferguson had produced 11 tons, 18 cwt of bar iron, valued at $952, and 2 tons 54 lb of blooms worth $121.92. From one man this amount of iron was not unimpressive. The works finally seemed to be moving along. But the total production was far below production at other bloomary operations in the vicinity, so some problems with iron making remained.[46]

The proprietors continued. Porteous had been instructed to find out if a rolling mill at Clintonville or Keeseville could roll 2 or 3 tons of blooms, but Keeseville only rolled bars. But problems did crop up, inevitably. At the end of July, the forge chimney collapsed, bringing the works to a halt. And when problems came, they arrived together, for although Clintonville did indeed roll blooms, the results proved disheartening. Not only did they lose much of their weight because they had been poorly made, they cost twice what they could have sold for. Even for iron to be used at the works, such a cost was prohibitive.[47]

Nonetheless, 1839 had to be chalked up as the best year yet for the works. Clearly the highlight was the excellent report by Johnson, the Philadelphia chemist. This test and the work of Emmons appeared to restore the interest and the hopes of the owners. With the return of confidence, came a renewal of testing and probing. Porteous shipped out 250 pounds each of 4 kinds of ore from the property, for testing by British iron masters. The desire clearly was to attract interest. The year 1839 also saw the partners actually form a company, chartered as the Adirondack Iron and Steel Company, with the right to raise $1 million in capital. Passed on April 12, 1839, by the state legislature, the charter had a 25-year lifetime. Problems remained in abundance, but the partners seemed, finally, to have launched their enterprise.[48] Certainly their dreams extended beyond the 25 year life of the incorporation.

## Notes

1. Archibald McIntyre to Duncan McMartin, 2 January, 1833, MS 61-62, Box 2, Folder 10. Doolittle lived in Vermont, where he had patented a circular brick kiln for making charcoal with greatly improved efficiency. McIntyre urged McMartin to go visit Doolittle and determine the kiln's suitability to the works. Very shortly thereafter the works were using a kiln for ore roasting, at least, and probably for charcoal making as well. But it is not known if it was Doolittle's patent, as the rights to it cost $2 per cord of kiln capacity. Remains of kilns found at the village did not match the description of Doolittle's kiln. McIntyre to McMartin, 9 January, 1833, MS 61-62, Box 2, Folder 10; Copied letter from Seth Hunt of Bennington, Vermont, to McIntyre, 3 January, 1833. Doolittle obtained the patent on 14 December, 1829 for "Charring Wood for Charcoal," U.S. Patent Office, <u>Subject - Matter Index of Patents for Inventions issued by the United States Patent Office from 1790 to 1873</u>, Volume 1, (Washington, 1874), p. 285.

2. <u>Ibid</u>., 18 January, 1833.

3. <u>Ibid</u>., 2 April, 1833.

4. Duncan McMartin to Margaret McMartin, 16 June, 1833, MS 61-62, Box 2, Folder 7; Archibald McIntyre to Duncan McMartin, 3 July, 1833, MS 61-62, Box 2, Folder 10; David Henderson to Archibald McIntyre, 8 August, 1833, MS 61-62, Box 2, Folder 8B.

5. Archibald McIntyre to Duncan McMartin, 13 April, 1833, MS 61-62, Box 2, Folder 10.

6. David Henderson to Archibald McIntyre, 14 September, 1833, MS 61-62, Box 1, Folder 4; Duncan McMartin to Archibald McMartin, 14 September, 1833, MS 61-62, Box 2, Folder 7.

7. Archibald McIntyre to Duncan McMartin, 6 June, 1833, MS 61-62, Box 2, Folder 10. The Lycoming lands were at Ralston, in Lycoming County, Pennsylvania. Despite the potential mentioned by McIntyre, the coal mine at Ralston went through some of the same teething problems encountered at McIntyre. Not until after McIntyre's death did the mine become, for a short while, a producing property.

8. <u>Ibid</u>.

9. <u>Ibid</u>., 11 November, 1833.

10. <u>Ibid</u>., 3 July, 1833.

11. Ibid., 13 April, 1833; 6 June, 1833; Henderson to McIntyre, 9 September, 1833, MS 61-62, Box 1, Folder 4.

12. Archibald McIntyre to Duncan McMartin, 11 November, 1833, MS 61-62, Box 2, Folder 10.

13. David Henderson to Archibald McIntyre, 14 September, 1833, MS 61-62, Box 1, Folder 4.

15. Ibid.; McIntyre to McMartin, 11 November, 1833, MS 61-62, Box 2, Folder 10; 6 January, 1834, MS 61-62, Box 3, Folder 11A.

16. McIntyre to McMartin, 11 February, 1834, MS 61-62, Box 3, Folder 11A.

17. McIntyre to McMartin, 6 January; 27 January; 11 February; 25 February; 8 April, 1834, MS 61-62, Box 3, Folder 11.

18. Ibid., 8 April; 18 June; 28 May, 1834.

19. Archibald McMartin to Duncan McMartin, 23 June, 1834, MS 61-62, Box 2, Folder 6.

20. Henderson to McIntyre, 6 August, 1834, MS 61-62, Box 3, Folder 11.

21. McIntyre to McMartin, 19 September, 1834, MS 61-62, Box 3, Folder 11. The Dalaba Furnace was the first blast furnace erected in Port Henry on Lake Champlain.

22. Henderson to McMartin, 2 October, 1834, MS 61-62, Box 3, Folder 11; McIntyre to McMartin, 28 October; 11 November, 1834, MS 61-62, Box 3, Folder 11.

23. McIntyre to McMartin, 2 October, 1834; 29 January; 28 August; 28 September; 7 May, 1835, MS 61-62, Box 3, Folder 11.

24. James G. Wilson, ed., Appleton's Cyclopedia of American Biography, (N.Y., 1888), V:204-5; Masten, (1968), pp. 72-75; McIntyre to McMartin, 19 July; 30 July; 15 November, 1836, MS 61-62, Box 3, Folder 11; See also William C. Redford, "Some Account of Two Visits to the Mountains in Essex County, New York in the Years 1836 and 1837..." American Journal of Arts and Sciences, Volume XXXIII, (July and December, 1837).

25. McIntyre to McMartin, 17 September, 1836, MS 61-62, Box 3, Folder 11.

26. See Annual Reports of the Geological Survey of the State of New York in Assembly Documents of the State of New York, 1837, Volume 2: Document 161; 1838, Volume 4: Document 200; 1839, Volume 5: Document 275; 1840, Volume 2: Document 50; 1841, Volume 5: Document 150. Emmons's report was contained in the large annual statements. The final report was published as The Natural History of the State of New York, (Albany, 1842). Emmons's report was "Geological Survey of New York State, 2nd District," Part 4, Volume 2. Such state surveys demonstrate one of the many not-easily recognized ways in which government aided the process of industrialization in the United States.

27. Ebenezer Emmons, "Report of E. Emmons, Geologist of the 2nd Geological District of the State of New York," 15 February, 1838, in Assembly Document 200, 1838, Volume 4, p. 224.

Notes

28. DeSilver's Philadelphia Directory and Stranger's Guide, (Philadelphia, 1841), p. 135; Eleutherian Mills Historical Library, Wilmington, Delaware, Card Catalog; W.R. Johnson, Notes on the Use of Anthracite in the Manufacture of Iron, (Boston, 1841).

29. Ebenezer Emmons, "Fourth Annual Report of E. Emmons, of the Survey of the Second Geological District," 1 January, 1840 in New York Assembly Documents, 1840, Volume 2, Document 50, pp. 305-311. Johnson originally published his article, "Experiments on Two Varieties of Iron Manufactured from the Magnetic Ores of the Adirondack Iron Works, Essex County, New York, "American Journal of Arts and Science, 36(July, 1839): 94-105.

30. Emmons, "Fourth Annual Report...," p. 292.

31. Ibid.

32. Ibid., pp. 296-7.

33. Ibid., p. 298.

34. Ebenezer Emmons, "Papers and Documents relative to the iron ore veins, water power and woodland, etc., etc., in and around the village of McIntyre, in the town of Newcomb, Essex County, State of New York...," (New York, 1840); "Advantages of the works and property of the Adirondac Iron & Steel Company, for the Manufacture of Cast Steel, of superior quality, on a large scale, at a cheap rate, "(Philadelphia, 1851); "Adirondack Iron and Steel Company, New York...," (New York, 1854).

35. A Gazetteer of the State of New York, (Albany, 1842), p. 51.

36. McIntyre had moved to Albany in November, 1835, in what could be called retirement; in 1838, he was 66 years old and could not have endured the rigors of life at McIntyre year 'round. Henderson owned the American Pottery Company in New Jersey, and could not devote his full time to the iron works. Nonetheless, Henderson assumed McMartin's role of most directly interest owner. McIntyre to McMartin, 17 November, 1835, MS 61-62, Box 3, Folder 11.

37. Masten, 1968, p. 81; De Silver's Philadelphia Directory and Stranger's Guide, 1831, (Philadelphia, 1837), p. 188.

38. McIntyre to Porteous, 10 November; 15 December, 1838; 3 January, 1839, MS 61-62, Box 1, Folder 3.

39. McIntyre to Porteous, 10 November; 21 December; 31 December, 1838; 8 January; 17 January; 25 January; 8 February, 1839, MS 61-62, Box 1, Folder 3; List of Archibald McIntyre cash payments to Porteous, or for articles, 2 November, 1838 to 27 May, 1839, McIntyre Correspondence, Ticonderoga Historical Society, Ticonderoga, New York. Hereafter cited as THS.

Notes

40. Henderson to McIntyre, 8 March, 1837, MS 61-62, Box 1, Folder 4.

41. Laws of the State of New York, 1839, Chapter 120, pp. 98-99, McIntyre to Porteous, 19 January; 11 July; 15 July; 30 July; 23 November, 1839, MS 61-62, Box 1, Folder 3.

41. McIntyre to Porteous, 3 January; 12 June; 17 January, 1839, MS 61-62, Box 1, Folder 3.

43. Porteous letter, undated and unaddressed, THS; McIntyre to Porteous, 17 January; 29 April; 12 October; 30 October; 27 November, 1839, MS 61-62, Box 1, Folder 3.

44. McIntyre to Porteous, 17 January; 18 February, 1839, MS 61-62, Box 1, Folder 3.

45. McIntyre to Porteous, 17 January; 3 January, 1839, MS 61-62, Box 1, Folder 3; Payroll sheets for Jonas Putnam, 13 April to 12 December, 1839; W.J. Austin, 13 April to 1 June, 1839; O.S. Hender, 27 April to 25 May, 1839; E. Annis, 12 October to 16 November, 1839, MS 74-18, Box 1, Folder 9; Balance Sheet, 1839; MS 74-18, Box 1, Folder 9; Henderson and McIntyre to Porteous, 5 June, 1839, MS 61-62, Box 1, Folder 3.

46. Henderson to Porteous, 6 April; McIntyre to Porteous, 13 April, 1839, MS 61-62, Box 1, Folder 3; Iron Forge Stock as of 29 June, 1839; Iron Stock as of 1 July, 1839, THS. Walter Johnson in his 1839 report noted that forges in Clinton and Peru produced 3,000 to 4,000 tons annually. This must be a composite figure of several companies, for single forges could not have reached that tonnage. But with only 13½ tons to show, the McIntyre forge clearly was encountering difficulties.

47. Henderson and McIntyre to Porteous, 5 June, 1839; McIntyre to Porteous, 11 July; 1 August; 12 October; 23 November; 19 December, 1839, MS 61-62, Box 1, Folder 3.

48. McIntyre to Porteous, 12 January, 1839, MS 61-62, Box 1, Folder 3; Laws of the State of New York, 1839, Chapter 158, pp. 134-6.

# CHAPTER III

As the year 1840 approached, the works seemed to have settled into a pattern of complacency. With the forge not operating, Porteous had 8 men working on the railroad, 4 hands making coal, 4 laboring on the Newcomb farm, and 6 on the village farm who helped with the charcoal kilns. The wage was $14 a month for all.[1] But although Porteous made great efforts, the years 1840 through 1842 saw very little advancement. The tempo of events continued almost unchanged from those established the very first year. Supplies continued to be an annoyance every fall and winter. In January, 1840, the standard ration of pork arrived, followed by less mundane articles like Arrowroot, 12 pocket knives and a dozen Loco Foco matches. The problem remained that the village of McIntyre was unable to support itself. Foodstuffs and seed nearly always headed the shopping list, but standard industrial items, as shown in this request by Porteous also had to go in on sleds. Among the items needed were 6 sawmill files, shoe leather, rope, horseshoe nails, 12 brooms, weights and a scale, 2 bars of 7/8-inch cast steel for drills, 1 bar of 2 inch blister steel for drilling hammers, 2 18-pound egg-shaped sledges for breaking ore, 2 or 3 kegs of powder, books and 6 kitchen knives.[2]

Labor problems continued to bother Proteous. Ferguson, the bloomer, quit - among other reasons his wife was ill - and the forge could not operate anyway. Porteous continued to dispute with the colliers over wages, and eventually lost them. In answer to his manager's constant complaints about the help, and especially one whom McIntyre trusted, the older man wrote, "You have been so annoyed by rogues that I am not surprised that you should become somewhat suspicious of any one you have to deal with. But let me beg of you not to suspect without cause, nor to believe all that tale bearers say."[3]

A more serious incident happened in 1841. Due to its isolation, the McIntyre village had remarkably few brushes with liquor, a problem that plagued many other factories and industries. But in March, 1841, Porteous fired a worker named Neill for supplying spirits to another worker, and thus enabling both to get drunk. They almost burned the boarding house in the process, by knocking pipe ashes onto a blanket.[4]

As for iron-making, little happened between 1840 and 1842. In 1840, Henderson went north with ". . . a mason from New Jersey to erect the forge chimney, and fix properly the hot blast machinery, and he may accompany the mason, too." This hot blast arrangement, of the "most improved system." as Porteous called it,[5] brought the Adirondack forge into line with the developing American Bloomary process discussed above. But with the loss of Ferguson, no bloomer remained. So as he had the mason, Henderson arranged for a bloomer, an assistant, and a miner, all from Jersey City, to go to the works to try their hand at operations. This group appeared very professional when they arrived in late July, 1840, for Porteous anticipated running night and day, and when the second stack had been built, other bloomers were to follow. These expectations do not seem to have been met, for although the chimney went up fairly quickly, Porteous later commented that the forge was not doing very well. Blanchard, the New Jersey bloomer, had decided to switch to the Sanford ore, which proved much easier to loup. Things did not go well, for by the end of the year Henderson admitted he was now ready to quit.

> I see nothing but Adirondack will have to be shut up for the present, and indeed in such event it is a pity that more provisions are sent up this year. I have foreseen since it was found that we could not go on in a small scale by ourselves by blooming to pay expenses, that the establishment would be shut up - (by shutting up I mean merely to have some person there to take care of the place) unless indeed some arrangement could be made in England as has been proposed.[6]

But Henderson's depression was only temporary, for the "arrangement" he mentioned represented the first really serious contact with England and the investors whom the proprietors hoped to interest in their property. Henderson had met the brother of Charles Sanderson, the noted Sheffield steel maker, who in New York watched the steel company's interests in America and scouted for likely prospects. Moreover, Sanderson wanted to give the McIntyre ore a true test using "his patented method of smelting."[7] Finally, there seemed a chance to interest a "capitalist" in their works.

And Sanderson remained interested in the Aidrondack works. The plans were laid out for Porteous by McIntyre in April, 1841. At the end of May, Henderson and 2 or 3 others were slated to arrive at the works, primarily for a fishing trip. One of the visitors, a Mr. Sanderson,

> . . . brother of the famous steel manufacturer of England, goes more to see, examine, and report to his brother, on our mining and other property than to fish. The Sanderson's have read about our ores, and are wishing, I understand, to undertake at our place in working the ore upon a new plan lately invented by one of them by which the rich magnetic ores can be worked at a vastly less expense than by any of the old processes.[8]

To utilize Sanderson's process of melting iron ore, as he patented it in October, 1838, the works needed a large quantity of bricks - about 150,000. James Robertson, Archibald's brother, went north to superintend this operation, taking with him a machine, probably a pug mill, to work the clay.[9] At this point, there occurred a gap in the correspondence. All that could be determined was that the brick makers did actually begin working. Nelson John Beach, a surveyor on the new road then being laid out from Carthage on Lake Ontario to Crown Point stopped at the works in June, 1841. Beach wrote that he found 3 families at McIntyre, and 15 men making brick and farming. A forge, sawmill and 150 acres of clearing constituted the works.[10]

The fate of the Sanderson involvement remains unclear, although it obviously did not last. Nor can it be determined if the patented smelting process worked. Sanderson's plan was one of many efforts to produce steel directly from ore, or cast iron. But only Bessemer and Kelly succeeded. No iron seems to have been made in 1841. Beach did not mention it, and McIntyre had written in February that he anticipated not using any charcoal during the year.[11] And as the correspondence gap extended into 1842, little can be guessed or surmised as to why Sanderson lost interest. The Sanderson case, however, demonstrated the value of Emmons' booster work, for as McIntyre had said to Proteous, the steel works owner had read about McIntyre. That could only mean Sanderson had discovered the New York company through Emmon's or Johnson's reports.

Not a single letter from 1842 survived, producing a maddening hiatus in the chronology of events. But little seemed to have changed in the interval, for in the very next letter in the series, Henderson answered a query from McIntyre as to the value of adding a new stamper to the works. Even though the price was high, he wrote, they almost had to adopt that course. "There is no medium between an abandonment of the village and farm - and carrying on some iron-making." Abandonment would only give the works a bad name and make a sale all but impossible. Their goal had to remain that of getting the iron onto the market in order to prove its quality.[12] Problems in the manufacture of iron, however, continued. As had happened before, the owner resorted to a scientific approach to solve the difficulties. This time Henderson determined to run the chemical tests himself. It might be well to pause and discuss modern metallurgical and geological understanding of the McIntyre ores. The ores, modern geologists say, are not simple iron oxides, but also contain a significant quantity of tatanium dioxide, $T_iO_2$. Magentic separation removes a large part of the iron from the ilmenite, as the $T_iO_2$ ore is known. But the magnetite - the iron ore - even after being separated, still contains 30 to 35% ilmenite intergrowths, apparently caused by heating during the formation of the rock. This feature, even today, marks the crucial objection to the use of these iron ores, for even modern concentration and milling processes cannot completely separate the ilmenite from the magnetite. The presence of the titanium clearly has an influence on the east of manufacturing iron,[13] but just how it affected the forge process is not clear. At a later point in the history of the works, this question became one of lively controversy.

Henderson, of course, had a far less thorough knowledge of the ores at McIntyre. But he derived a theory about the ores. After crushing the ores as fine as sand, magnetic separation resulted in two separate kinds of material. Henderson insisted that these were two different oxides of iron. The magnetic oxide he called protoxide of iron, while the leavings were peroxide of iron, using accepted terms of the period. The two oxides were not chemically joined, he argued, because an acid dissolved the protoxide but not the peroxide. Henderson believed the problem at Adirondack stemmed from mixing the two oxides, each of which melted at different temperatures. Tests, moreover, showed that not all of the ores were in the same. The black ore, directly across the river from the village, and the East River ore, on Calamity Brook, were nearly all peroxide; while the large grained black ore had little peroxide, appearing as crystals in the protoxide. The Sanford ore contained a mix of both.[14] It seems that Henderson had managed to roughly separate the ilmenite and magnetite, and confused both as iron ores, due to the intermixing of iron and titanium within the two ores.

Henderson talked to several metallurgists and chemists about his discovery, who initially rejected his hypothesis. Dobson, a noted Philadelphia metallurgist, and James C. Booth, a Philadelphia chemist, initially disregarded, but later, according to Henderson, accepted his theory. Booth carried a considerable amount of weight in the small field of American chemistry. A University of Pennsylvania graduate with a doctorate from RPI in 1831, he travelled to Europe in 1832 where he studied in Wöhler's private laboratory. Booth later spent time at G. Magnus's lab in Berlin, and also studied in Vienna and England until 1835. Upon his return to this country in 1836, the chemist opened a lab in Philadelphia, "the first of its kind in the United States, for instruction in chemical analysis and chemistry applied to the arts." He published numerous books later in his career, including The Encyclopedia of Chemistry, Practical and Theoretical (Philadelphia, 1850), which long remained a standard work, being reprinted 5 times until 1883 as well as being republished in London. Moreover, Booth also performed surveys and tests for individual companies, much as Johnson had.[15]

Nor were Booth and Dobson the only sceintific figures Henderson approached. And as the problem of analysis became more complicated with the realization that titanium somehow was present in the ore, Henderson involved others in his work, as this letter to McIntyre made clear.

> Robertson told me an extraordinary thing, vixt. that Professor Johnson told him he had analyzed our ores, and found that they contained from 16 to 18 percent of titanium in the shape of an acid!! - Professor John Murray of Edin, analyzed them and found only 1 percent of titanium and manganese which is of no account whatever. The very best ores known in Russia and Sweden of the magnetic oxide contain a small portion of titanium. Murray was one of the first chemists in the world. Johnson stands fair as a scientific man - what are we to believe? - Beck gives no titanium. Mr. Steele says that what Johnson says is absolute nonsense - 16 to 18 percent of titanium in it would totally prevent it from making iron at all. I place less and less confidence in many that are called scientific. I am determined, with the aid of Mr. Steele, to go through a perfect analysis myself and then I will be satisfied. There is no difficulty in ascertaining about this titanium and the amount of it."[16]

Henderson repeated those closing sentiments several times, especially on Johnson's comment about 16 to 18 percent of titanium in the ore. But he continued to work on the analysis with Steele. The best authorities, Henderson wrote, say titanate of iron consists of protoxide and peroxide of iron, 86 parts, titanic acid, 8 parts; manganese oxide, 2 parts; gangue 1 part, loss 3 parts. But Henderson only found traces of titanium - in most tests 1 1/4 percent by powder. His test was fairly simple - taking 30 grams of ore as powder, he mixed it with potash. After calcining for over an hour, the titanate combined with the potash. When the mixture was dissolved in water, only the iron settled out. Then he added gallic acid to the water, producing the beautiful red color indicative of titanium, but little precipitate. Moreover the actual separation of the protoxide and peroxide of iron had proven impossible. As Henderson commented, "How Mr. Johnson of Philadelphia could get from 16 to 18 percent is a mystery to me." Another New York chemist, Chilton, considered Johnson's findings impossible. Yet Johnson proved closest to being correct, although his figure was still 50 percent short of the average titanium dioxide content of the McIntyre ores.[17]

The manner in which Henderson put his chemical experiments to use at the works offered an interesting insight into how difficult it can be to integrate scientific knowledge with practical processes, especially when the scientific knowledge, as can frequently be the case, involves guess-works. Henderson attempted to formulate a specific set of operating plans to test his ideas of the two oxides contained in the ore. The primary alterations required for this experiment were the addition of a new set of ore stamps and a new magnetic separator. After being finely crushed, the separator could divide the ores, for easier working. The separator was to be the second used at McIntyre. It had 2 wooden rolls studded with some 5000 magnets. A fixed brush wiped the protoxide, or magnetic ore, off the magnets. A Mr. Odiorne of Boston claimed to have patented this machine and offered to sell one for $200, although the actual price paid was $137.[18] After minor repairs to the magnets, the machine was shipped north and installed in the works along with a new water wheel to power it and the stamps. Although exposure to water on the way in weakened the power of the magnets, by 18 June, Porteous had the machine in place and operating satisfactorily.[19]

Henderson had apparently heard about Ordiorne's machine because a similar separator by the Bostonian had been erected for the Penfield forge at Mineville, near Lake Champlain. Later, Penfield joined Charles F. Hammond on forming the Crown Point Iron Company, but in the late 1830's, Penfield produced iron in a manner identical to the Adirondack Company. The Mineville separator had cost $950 and separated 8 tons of ore daily. Moreover, the machine had run for 2 years without trouble. The intriguing feature about the Penfield separator was the provision made to recharge the magnets by a galvanic cell built by Joseph Henry. This may have been the first practical utilization ever of an electro-magnet.[20]

The Odiorne machine at McIntyre may have replaced the water separator that Proteous had erected in 1839. Although the only reference to the water separator occured in the payroll records, Emmons wrote in his 1840 report,

> Washing or separation is a necessary operation in a majority of veins, especially if they are to be worked in a forge. . . .At one time, the magnet was considered the best instrument for separating the ores; it is, however, now going out of use. The improved mode of separating by washing, has superseded the use of the employment of the magnetic machine.[21]

Emmons did not specifically refer to such an installation at McIntyre, but to assume he meant Adirondack would not be too far off base, given the geologist's close connection with the works.

Unfortunately, Ferguson, once again the bloomer, met with little success despite the new machinery. The iron made too slowly, and the bloomer had trouble attaining the proper temperature to make loups into bars. The iron produced, though, looked good. Even the peroxide - the non-magnetic ore - was tried, with peculiar results. It melted easily and came out of the forge as a plate of steel that could be broken only with difficulty. With a grain "as fine and beautiful as cast steel . . ." this definitely was, ". . . a curious material."[23]

But the results did not please Henderson, who although planning to finish the tests, was very depressed.

> We have looked upon these mountain masses of rich ore with wonder, but for all the iron making that any of us or those connected with us would carry on, a very insignificant vein would just be as good. - My only hope had been that if two fires could be profitably carried on here, to assist in keeping the place alive, and sending the iron out by sleighing, and getting a character for its quality in the market - that then the place would have a chance of being taken notice of by capitalists. The want of a good communication out is however against us. -
>
> * * *
>
> Should these experiments fail, it will be a very serious question to decide what should be done. The property here should be preserved from ruin if possible to take advantage of any chance which may hereafter arise. I fear, that you and I may both make up our minds that the large amount of money spent from first to last, has been spent in vain, at least for us. I have expended upon it over $36,000 - and you I believe a good deal more. I am compelled at length to consider it lost. Yet something may cast up unlikely as it seems.[24]

Henderson's perserverance and McIntyre's willingness to follow must be counted the key reason for the continued existence of the firm. As soon as he had left McIntyre, then known as Adirondac, or Adirondack, where he had supervised the tests in June, Henderson started pondering the results. He considered one problem to be the application of too much heat by the bloomer. By July 13, Henderson had decided "I am determined to superintend a thorough set of trials . . . if I can find a bloomer - a sensible man, who can bear consultation and advice."[25]

Moreover, Henderson was seriously willing to consider use of the Clay plan. Developed in England by William Neale Clay, this process proposed to convert iron ore to wrought iron via a three-step direct process. The ore and charcoal were mixed in a clay retort, and heated until iron reached a metallic state. This spongy iron was then heated in a puddling furnace and "balled," and finally hammered into blooms under a tilt hammer. Earlier in the year, the owners had discussed adopting this particular means of making iron, but decided to move cautiously with experiments at the forge instead. But with the discouraging problems at the works, Clay's process again came to mind, despite the need to get firebrick and iron doors to the works for a furnace, and to find an English baller, or puddler. The fact that McIntyre and Henderson even knew of Clay's process indicated their careful efforts to keep abreast of changes in the industry. Clay obtained patents in 1837 and 1840 for this process which was tried in a small forge near Glasgow, and then at a large works near Liverpool, from October, 1845 to July, 1846. The process failed commercially due to the length of time needed to melt the iron and because of the wear on the kilns and retorts. The iron was of excellent quality, however. But Henderson and the others were contemplating the plan in 1843, well before the large-scale experiment had commenced in Liverpool.[26]

As matters developed, the Adirondack Company did not adopt the Clay plan, for a discovery at the works changed Henderson's thinking entirely. Porteous found water standing only 4 inches under the forge. Steel informed the owners that the steam thus produced seriously impeded the working of the iron, by producing iron oxide on the surface of the loup. Quickly, the younger Scotsman planned a second trip to the works, taking a New Jersey bloomer with him, to work with 2 local men already there. Porteous had raised the forge by the middle of September, and the trials began anew.[27]

This time, Henderson believed he had finally found the solution to their difficulties. McIntyre, who visited the works in the midst of the experiments wrote that he: "found Henderson and the Jersey City Bloomers in high spirits, having discovered that our ore readily run into plate metal, which is readily converted into fine double refined iron, which the Bloomer had already performed."[28]

Suddenly the optimism and confidence returned. McIntyre confided to his journal:

> That fine plate iron can be produced at once from our ore very much surprised Belcher, the N.J. Bloomer. This metal has heretofore (so far as we know) been produced by remelting pig metal. Our ore is certainly peculiar and different from all others in this region; it melts more readily, and more readily combines with carbon, producing at once this very valuable plate metal, which is readily balled into excellent refined iron. Belcher thinks that a 12 foot furnace wd. melt of this metal from 2 to 3 tons per day at not exceeding 200 bushels coal to the ton, and that this would then ball it into bar iron. This plan must be tried, and if it succeeds as we have every reason to believe it will, it will exceedingly enhance the value of this property, which has cost us so much anxiety and money. Belcher is busy by Henderson's orders making bloomed iron. He is not a good Hammersman, altho' an excellent fireman. Ferguson, who I took with me from Schroon is the Hammersman, and a very good one."[29]

To test his idea, Belcher put up a 3-foot high furnace, labeled the pepper pot by Ferguson, holding a bushel of charcoal and 20 pounds of deoxidized ore, which produced a 12-pound plate of iron. McIntyre commented that, "We have now pretty strong and satisfactory evidence that our ores are much better calculated for the furnace than the Bloomary, and that if it will produce plate metal at once from the ore, an unheard of thing, so far as we know."[30] Importantly, Ferguson proved able to draw the plate metal out into bars in the forge, managing to produce 700 pounds of superior refined iron. Various tests proved that the iron was "of very great strength and tenacity."[31]

From this point, the genesis of the first blast furnace at Adirondac can be traced. The owners left on October 3rd to head back to Albany and Jersey City, but stopped at Port Henry to talk with Mr. Jackson, agent for the Port Henry Iron Company, successor to the old Dalaba Furnace built in 1882.[32] This discussion, and another that evening, led to the decision to construct a blast furnace. McIntyre recorded the events in his journal,

> Mr. Taylor, an excellent Millwright, Mr. Henry, the principal furnace keeper of the Port Henry furnaces, and Mr. Rogers a furance builder spent a portion of the evening with us, and we had a consultation with all as to our future proceedings at Adirondack. Mr. Henry, we ascertained had charge of the Port Henry furnace some 8 or 9 years ago, when Judge McMartin sent several tons of our ore to be tried in the furnace, and altho the clerk when asked about the quality of our ore, pronounced it good for nothing,

> yet Mr. H. Now informs us that a very superior metal to any that had even been run in that furnace. He is decidedly of the opinion that in a small furnace, say 20 feet high, our ore will produce regularly plate metal, such as was produced in our forge, and 5 tons daily. On full consultation determined to erect a furnace next year and we have ordered hearther stones from Meacham's Quarry, Mr. H. considering those as good as those of Haverstraw. He did recommend, however, that the temps stone should be got from Haverstraw, which he or Mr. Taylor agreed to order.
>
> Mr. Henderson compiled a Memorandum of all that is to be procured for our contemplated work.[33]

Once before, in a moment of despair in the early 1830s, McIntyre had mentioned that ore might work better in a furnace. Now that conjecture had been acted upon.[34] The Adirondack Iron & Steel Company had embarked on a major expansion program.

# Notes

1. Porteous to McIntyre, 9 January; 25 October, 1840, MS 74-18, Box 1, Folder 1; McIntyre to Porteous, 22 January, 1840, MS 61-62, Box 1, Folder 3.

2. 1840 Account Sheet, MS 74-18, Box 1, Folder 9.

3. Porteous to McIntyre, undated - ca. February, 1840, MS 74-18, Box 1, Folder 1; McIntyre to Porteous 6 February, 1840, MS 61-62, Box 1, Folder 3; 28 August, 1840, MS 74-18, Box 1, Folder 2.

4. Porteous to McIntyre, 31 March, 1841, MS 74-18, Box 1, Folder 1.

5. McIntyre to Porteous, 22 January, 1840, MS 61-62, Box 1, Folder 3; Porteous to Obadiah Eddy, 5 March, 1840, MS 74-18, Box 1, Folder 9. Obadiah Eddy was an Essex County bloomer to whom Porteous offered Ferguson's job at $20 per ton.

6. Porteous to McIntyre, 20 April, 1840, MS 74-18, Box 1, Folder 1; McIntyre to Porteous, 28 July, 1840, Folder 2, Porteous to McIntyre, two undated letters - (August, 1840 by content), Folder 1; Henderson to McIntyre, 21 December, 1840, MS 61-62, Box 1, Folder 4.

7. Henderson to McIntyre, 26 December, 1840, MS 61-62, Box 1, Folder 4. Henderson may have been in touch with Sanderson earlier, for Porteous had been asked to ship ore samples to Henderson on October 25. Sanderson had first produced steel as early as 1822. K.C. Barraclough, _Sheffield Steel_, (Buxton, England, 1976), p. 53.

8. McIntyre to Porteous, 10 April, 1841, MS 74-18, Box 1, Folder 2.

9. Porteous to McIntyre, 31 March, 1841, MS 74-18, Box 1, Folder 1; McIntyre to Porteous, 2 March; 10 April; 21 April; 26 April; 19 June, 1841, Folder 2; Bennet Woodcroft, _Alphabetical Index of Patentees of Inventories_, (London, 1969), p. 112; patent #7828, 11 October, 1838. Again, Henderson may have had plans to use Sanderson's process well before December, 1840, for in August, 1840, the owners had started a brickmaker up from Albany to take a look at the materials at the works. If he liked them, the man was going to make 150,000 to 200,000 bricks in 1841. But the man got sick on his way in and never made it. Still, in the same letter in which Henderson mentioned the Sanderson trial, he also mentioned plans to make brick in 1841. McIntyre to Porteous, 1 August; 10 August, 1841, MS 74-18, Box 1, Folder 2; Henderson to McIntyre, 26 December, 1841, MS 61-62, Box 1, Folder 4.

10. "101 Years Ago," _Cloudsplitter_, June, 1942, 5, number 6 (June, 1942):5-6. Beach's work was representative of several other efforts to improve the miserable state road that served as the only tenous link with Lake Champlain. The legislature authorized the new road on April, 1841. McIntyre urged Porteous to be ready to aid the road commissioners, and to try to get the road as near the works as possible. Beach wrote back to Porteous in October, giving him the route chosen. A road from the works could hit the state route at the Boreas River, after running to the right of North River Mountain and past Perch Road. _Laws of the State of New York_, 1841,

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Chapter 96, passed 14 April, 1841; McIntyre to Porteous, 10 April, 1841, MS 74-18, Box 1, Folder 2; James McIntyre to Archibald McIntyre, 19 October, 1841, MS 65-28, Box 5, Folder 19a.

11. McIntyre to Porteous, 10 February, 1841, MS 74-18, Box 1, Folder 2.

12. Henderson to McIntyre, 23 January, 1843, MS 61-62, Box 1, Folder 3.

13. Thomas Joyce and John Oxenford, "The McIntyre Blast Furnace," Tahawus Cloudsplitter, XXII, no. 1 (January-February, 1970): pp. 10, 12.

14. Henderson to McIntyre, 13 February; 13 March, 1843, MS 61-62, Box 1, Folder 4.

15. Appleton's Cyclopedia of Biography, (New York, 1888) Volume I, pp. 316-7; The National Cyclopedia of American Biography, (New York, 1906) Volume XIII, pp. 245-6; The National Union Catalog, Volume 66, pp. 500-1.

16. Henderson to McIntyre, 13 July, 1843, MS 61-62, Box 1, Folder 4.

17. Henderson to McIntyre, 29 August; September 1, 1843, MS 61-62, Box 1, Folder 4; "McIntyre Development, Titanium Division, National Lead Company, Tahawus, New York, History and Development," ca. 1952, by the National Lead Company, p. 4. James R. Chilton was yet another of Henderson's scientific contacts. Apparently Chilton ran a shop in New York City, for in 1855 he published a catalog of instruments for sale. Like most men in his trade at the time, he also ran surveys for individual companies. James R. Chilton, A Descriptive Catologue of Chemical and Philosophical Apparatus, Chemical Preparations, etc., etc., (New York, 1855); "Lake Superior Iron, Analysis of the Ore...with Certificates of Practical Iron Workers and Others who have used it," (Detroit, 1856). From National Union Catalog, Volume 107, p. 205.

18. Henderson to McIntyre, 23 January, 1843, MS 61-62, Box 1, Folder 4. Thomas Odiorne, variously of Morgan and Malden, Massachusetts, and Portsmouth, New Hampshire, was the inventor and builder of the separator purchased for the works, although there is no patent record of such an invention. But Odiorne did have at least four other patents: Nail Manufacturing, 3 April, 1829; Regulating Height of Water in Boilers, 26 September, 1835; Fire Engine, 27 August, 1835; Pump for ships, etc., 27 August, 1835. U.S. Commissioner of Patents, A Digest of Patents Issued by the United States from 1790 to January 1, 1839, (Washington, 1840).

19. Henderson to McIntyre, 3 March; 7 March; 24 May; 9 June; 18 June, 1843; MS 61-62, Box 1, Folder 4.

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20. Ibid., 23 January; 1 February, 1843; Elmer Eugene Barker, The Story of Crown Point Iron, 1941 Typescript in Sherman Free Library, Port Henry, New York, pp. 7-8. (Also printed in New York History, 42(October, 1942):419-436.) The Penfield Foundation of Mineville displays the Henry equipment in the museum they maintain at the site of the Penfield forge and later concentrator of the Crown Point Iron Company. See also, Richard S. Allen, "Separation and Inspiration," (Ironville, New York, April, 1967).

21. Ebenezer Emmons, "...Fourth Annual Report...Geological Survey," 1840, p. 281.

22Henderson to McIntyre, 9 June, 1843, MS 61-62, Box 1, Folder 4.

23. Ibid., 24 June, 1843.

24. Ibid.

25. Ibid., 13 July, 1843.

26. Ibid., 13 March; 28 March; 13 July, 1843; John Percy, Metallurgy, (London, 1864), pp. 330-334.

27. Ibid., 25 July; 28 July; 29 August; 1 September, 1843.

28. McIntyre Journal, 22 September, 1843, MS 65-28, Box 6.

29. Ibid., 23 September, 1843.

30. Ibid., 27 September, 1843.

31. Ibid., 29 September; 2 October, 1843.

32Ibid., 5 October, 1843; Frank Witherbee, "History of Mining Industry," in Dr. Charles B. Warner and C. Eleanor Hall, History of Port Henry, N.Y., (Rutland, VT, 1931), pp. 43-5.

33. McIntyre Journal, 5 October, 1843, MS 65-28, Box 6.

34. McIntyre to Duncan McMartin, 16 July, 1833, MS 61-62, Box 2, Folder 10.

# CHAPTER IV

Henderson and McIntyre, especially the former, devoted the remainder of 1843 and early 1844 to planning the new furnace. Most important were the materials needed for the stack. By October 9th the partners had purchased 1,000 Bennington-made firebricks in Troy for $60 ton, as well as 450 key and arch bricks. Other items included 80 barrels of flour, fireclay, Russian and Philadelphia sheet iron, 46 feet of 8-inch tin pipe for the blast main, and many of the usual supplies. The annual resupply included a 140-pound smith's anvil, a 26-inch circular saw, scythe stones, files, borax, tobacco and cement.[1]

Apart from the furnace, the owners worried about other new installations necessary to complement the furnace. Thought was given to expanding the water power by diverting the Opalescent River into the East Branch (later Calamity Brook), and to adding a rolling mill to the works. Henderson and John Steele attended an auction in Orwigsburg, Pa., intending to purchase the equipment of the Franklin Works Rolling Mill, but the property had to be sold intact.[2] Henderson continued thinking about rolling their bars after the failure at the auction. He visited a Philadelphia works using wooden fly wheels, with a cast-iron rim, on their rolls and commented, "I am glad to know this, for it will be a savings at Adirondack."[3] But the inability to obtain a set of rolls cheaply crimped the plans to install a rolling mill at the works.

Henderson had desired the rolling mill to help deal with the inconsistency of the bars refined at Adirondac. So the Jersey City owner visited a number of iron works in the vicinity to ascertain how some of the larger works went about refining their iron and producing bars. Both the Cooper Iron Works and Stirling Works opened their doors to Henderson, as did at least one Philadelphia establishment. A puddling furnace was one option he considered for it could use wood instead of charcoal as fuel. But the expenses of two major additions could not be managed at the time. Instead, Henderson chose to improve the forge fires and hammer. He obtained exact copies of the plates used in the Stirling Works forges, and sent them to Daniel Taylor, the millwright in Port Henry who was to work on the blast furnace. The key to improving the hammer had to do with weight. An English puddler told Henderson that lumping fires could produce iron superior to puddled pig if the hammer was heavy enough. A 3-ton hammer would not be too large. Henderson drooled over a 1500-pound steam hammer in Philadelphia that worked 70 to 80 beats a minute, with a force up to 8 tons. But he settled for telling Porteous to get a T-hammer weighing 8 or 9 cwt. at Keeseville.[4]

The plan of the furnace proper also required some thought. Taylor reported that the old bellows would suit the needs of the furnace very well, if a new piston were installed. But the size and shape of the stack took more effort to determine. Numerous points and ideas came in for consideration, like the suggestion from a Mr. Ditmould, who approached

McIntyre about an invention to draw off the waste gases from the stack to heat a reverberatory oven to refine the pig. Henderson also made use of the standard treatises on the subject of metallurgy and iron-making, mentioning Mushet especially. But most of the decisions seem to have been left to the Port Henry builders who had actually erected blast furnaces before. Henderson's main concern was the size, which while initially pegged at the 12 to 14 feet mentioned by Belcher, grew to 20 feet after a discussion with Dobson, the Philadelphia metallurgist.[5]

Henderson appeared to consider all the sources he could in his amazingly thorough research about the iron works. He combined visits to other plants and long talks with the workmen, especially Englishmen, who he met, with published books, articles, and discussions with the scientists in his effort to make his choices. Moreover, Henderson conducted a series of experiments on the ore, primarily, related to the use of fluxes in the proposed furnace. He felt that they could probably smelt the ore without a flux, although he did hedge his bets by telling Porteous to get in some limestone. Flux, although it promoted greater efficiency in terms of more iron per ton of ore, raised the fuel consumption of the furnace. Henderson's reasoning on that score ran like this:

> But the ore is as cheap to us as any fluxing materials, and our course is plain - we must have a sufficiently strong blast, and run as much of the beautiful metal as possible from a certain quantity of fuel. In short, we must sacrifice ore to save fuel, and gain time.[6]

Henderson also planned how to run the furnace. He feared that a higher furnace would get too much carbon into the iron - extrapolating from his understanding that the furnace produced iron by heating the iron ore in contact with the charcoal more gradually than in a forge.

To overcome this difficulty, which really was groundless, Henderson aimed to use large charges of the black coarse-grained ore from near the village with a strong blast to move the material through the furnace quickly.[7]

Another factor that led to Henderson's experimenting was the sheer fun of laboratory work. His efforts to determine whether the ores contained titanium offered very little, if any help, in improving the working of the iron. The chemical manipulations seemed to intrigue Henderson as much as any results or recommendations. The aspiring experimenter seemed quite proud of himself when Booth and Dobson announced their agreement with his two oxides theory. And Henderson was equally pleased when Steel told him that Henderson's work had completely altered the machinist's understanding of magnetic oxides. "You seem to be fairly innocculated," he wrote to McIntyre, "as well as myself with a mania for iron chemistry. It is certainly a deeply interesting subject . . ."[8] And Henderson, by 1843, did appear hooked on constantly running experiments.

Before he started the work on fluxes, for which he used an assay furnace, Henderson figures out a problem that turned up in the bars produced in September. A bar left at the Burden Works in Troy for puddling came back with a disastrous report - they had not even been able to make horseshoes: the Burden speciality. Henderson could only assume the bar had not been refined completely, with one side not thoroughly decarbonized. Most puzzling was the contrast with the bars Henderson tested. Two local blacksmiths were involved and "all the trails excite the wonder of both blacksmiths, who declared that they never wrought such iron."[9] Henderson therefore placed little faith in the Burden test, and probably used his test as a reason not to put up a puddling furnace.[10] The work Henderson engaged in could occassionally be of practical value. He attempted to let the experiments guide the operation of the furnace and forge. But one should not lose sight of the other motive that pushed Henderson into chemistry and metallurgy, the fun of it. Playing David to the Goliath of the established chemical and metallurgical theories only enhanced the game.

By early in 1844, the key decisions had been reached, and the necessary parts, equipment, and supplies had reached the works. The last problems the owners faced was who will run the furnace? With a piece of hardward as complex and tempermental as a blast furnace, the works had to hire an experienced furnace master. Initially, Henderson, who must be considered general manager by this time,[11] had thought of hiring Mr. Henry, the furnace tender at Port Henry. But this seemed ungrateful conduct. And when they received a letter from Henry in which he assumed acting only as supervisor at $60 a month, and planned hiring two keepers at half that wage and two firemen at $1.25 a day, Henderson balked. Belcher saw no need for so many hands, so Henderson planned to hire only two keepers. Only experiment could determine the appropriate ore mix, "and we know more about the nature of the ores than Mr. Henry does."[12] Unfortunately, furnace masters and firemen proved difficult to find. Even in July, John Steele, sent on a trip to Connecticut, New Jersey, and Pennsylvania had great difficulty in locating suitable men. By the time the furnace started, it was too late in the year to find furnace men, especially in a year when many furnaces were operating. Steele was almost hired at a furnace in Connecticut.

While the owners coped with the employment problem, one of the very few times they had to do so, Porteous managed the construction of the furnace. The mason wanted $2 a day and forms, demands to which Henderson acceded, adding a post-script that was a constant complaint by the management. "His knowledge of building furnaces entitles him to more than ordinary mason's wages - and it will only be for a month or 6 weeks at furthest - but it is more than he can get elsewhere."[14]

The construction began as soon as the frost had gone, so by mid-May the masons started the furnace, while the millwright - Taylor - had the flume, water wheel, gears, and bellows underway. Taylor expected to complete the blower near the end of June. Impatient as always, Henderson left for the works early in June to find out how things had shaped up. June 15th, Henderson reported in person that the furnace was all lined with the hearth completed. Two masons had already departed, for the only masonry work remaining was the chimney over the furnace and "the place to hold the hot blast pipes."[15] This last comment is very interesting. It is the only indication that the owners used hot blast on this installation. The use of hot blast had only begun in the United States about five years before. For a small charcoal furnace, such an installation was truly remarkable.

Hot blast has originated in England to improve the efficiency of fuel, by funnelling the waste gas through a heat exchanger that raised the blast air temperatures before entering the furnace. The idea was that less fuel had to be wasted in heating the air and more charcoal was used to reduce the iron. The American iron industry began to adopt this innovation with the introduction of anthracite coal as a fuel. Coal fuel, as opposed to charcoal, required a stronger blast and higher temperatures in the stack. Hot blast stoves became mandatory equipment on anthracite furnaces, but turned up far less frequently on charcoal stacks, except on larger units. The Adirondack Company's installation of a hot blast stove in 1844 represented better than any other feature the keen awareness of the changes and developments within the industry exhibited by Henderson.[16]

Henderson had anticipated starting the furnace about the middle of July, a schedule he apparently kept. The lack of furnacemen must have been vexatious, but a gap in the correspondence has shielded our view of the first days of operation. In October, Porteous announced that the furnace had improved its performance a little, but not as much as hoped. Over the next few months, the letters were both numerous and detailed, providing an excellent view of the trials and tribulations of blast furnace operations.

With difficulties obviously having been encountered, the orders of the day called for experiments, especially with the charge. The day after McIntyre left in early October, the furnace had plainly not done well. Output was very low.

| | | |
|---|---|---|
| Wednesday | 6:00 a.m. | 569 pounds |
| Wednesday | 7:00 p.m. | 677 pounds |
| Thursday | 2:30 a.m. | 857 pounds |

The furnace continued much the same for the rest of the week. Then about 18 October, Porteous adopted a 142-pound charge: 115½ pounds of ore, 17¼ clay, 9¼ lime, with a follow-up of 86 pounds of dry ore, 7 of lime, 7 trap rock, and an additional 7 pounds of trap and 3 of lime. Five baskets of coal, each equal to 10½ bushels, provided the fuel. The results were not encouraging, but showed improvement. The crew tapped the furnace twice daily with the following yield:

| | | | |
|---|---|---|---|
| Monday | 6:30 p.m. | 955 pounds | |
| Tuesday | 6:00 a.m. | 952 pounds | |
| Wednesday | 6:00 a.m. | 749 pounds- | (fillers did not fill |
| | 6:00 p.m. | 934 pounds | as desired) |
| Thursday | 4:00 a.m. | 951 pounds | |
| | 4:00 p.m. | 1202 pounds | |
| Friday | 4:00 a.m. | 1168 pounds | |
| | 6:00 p.m. | 1177 pounds | |

Henderson believed that if the output could reach 30 cwt., the works might become self-sustaining. Other changes, used by all furnace keepers in their guests for the highest production from the lowest fuel consumption, included one suggested by Henderson just before he left in mid-October. The level of the tuyere and the angle at which it penetrated the furnace was a constant object of the furnacemaster's attention. This time, Porteous reported that after a day or two of irregularity the furnace settled down to produce the same amount of iron as before being placed on the level.[17]

The furnace crew was fairly small at this stage. David Adams was the master, with an assistant named Johnson. The two topmen were named Watson and Peter VanBulkenburgh. Two Scotsmen, brothers named Thompson, worked at Adirondac, one in the barn, and the other as a miner after transferring from the tophouse. But as though to match the problems with the furnace, the workers also were unsettled. As usual, the crux of the problem settled on wages. Adams, at $40 a month, had no money gripes, but found other reasons for disgruntlement. The topmen got $22 for 30 days work, Johnson received $12 a month. The miner got $25, the Thompsons earned $12 each, but wanted $16. This dispute raged throughout the fall.[18]

Adams complained more about having to work too hard. Most furnaces had a furnacemaster with 2 firemen, instead of just one assistant. Compounding Adam's work, as he saw, were the furnace difficulties. The cinder just would not run, so the crew had to shovel and haul it out of the hearth, instead of skimming it off the molten iron. Porteous had even continued the five basket charges of charcoal, despite McIntyre's orders, in order to combat this problem, without success.[19]

The experiments continued, as Porteous tried a new charge on November 1st. He tried a large charge of ore with less charcoal. 109¼ pounds of black ore and 33¼ pounds of Sanford ore were added to 20 of clay and 8½ of lime, followed by 114 pounds of dry black ore, 7 of lime, 7 of traprock. Porteous used 30 charges in 24 hours, with the following yields:

| | | |
|---|---|---|
| Tuesday | 11:30 p.m. | 1280 pounds |
| Wednesday | 10:30 a.m. | 1194½ pounds |
| | 11:30 p.m. | 1467 pounds |
| Thursday | 11:30 a.m. | 1335 3/4 pounds |
| | 11:30 p.m. | 1326 3/4 pounds |

Porteous believed in the need to get the furnace running properly, as he wrote to McIntyre,

> I am aware a better yield is wanted and have continued on these changes to try and gain it, and whether I can go beyond this I know not. David put more water on the wheel yesterday but they cannot use more than half the holes at the valve. If I cannot go beyond this, I will at once try any other change you may wish . . .

Proteous went on to discuss the condition of the stack itself, which everyone feared needed a major overhaul, in the bosh and additional height, as Henderson's early fears about carbon had not come true.[21]

November 7th began the major battle between Porteous and his furnace-master. Adams had burned out a water-cooled tuyere, something the bloomer in the forge had never seen. At the same time, Porteous had changed the charge, adding some 10 pounds more ore to the furnace, which deranged the operations. After the tuyere had burned out, the works manager had altered the blast, a move that greatly offended David Adams. Out of such small matters grew a major confrontation. Adams had talked the Thompson brothers into leaving the works with him.[22]

Porteous admitted he did not know how to manage Adams. Not until the tuyere burned out had Porteous done anything at the furnace, for fear of offending the tempermental Adams. Porteous continued:

> . . . in talking to him I told him it was taking 3 teams every day worth $9.00, 6 men on the furnace $6.50, two men most of the time burning and pounding ore and keep a Blacksmith and Carpenter waiting on him and 150 Bushels of charcoal and 5200 lbs. of ore each 12 hours and that he ought to be willing to assist all he could, but he only went on about his hard work, etc. I have always dreaded doing anything about the furnace you know better than I can tell you how he feels and acts when you or anyone tried to do anything to the furnace. I have been expecting to have heard from you whether to run the furnace or not. She has not paid and will not under the way he digs and blows, and no man can reason with him, and what is still worse his getting the Thompsons to clik in with him. I don't know whether he will go or not. Perhaps he will wait (to get an answer from McIntyre in Jersey City). . .I will run her at 12 or 1400 if I can each 12 hours, if not I will run her out till she is repaired and till I have further orders from you. I told him I would put my hand to the blast if I thought I could do any good, but if he or any man would come to me and show me it was wrong I would as willing put it as he said. After he commenced blowing he put the blast at the very same place after trying two hours to blow stronger and found he could make no iron and keep it

> there. I feared the way David acted to yourself, I would have trouble with him, and he acts much worse with me, and says both you and me have misunderstood him. But I thought I could get along with him for a few weeks till you come up as you expected you would when you left . . . [23]

What most bothered Porteous was his perception that Adams had deliberately damaged the furnace in a rage because Porteous supposedly interferred with the prerogatives of the furnacemaster. On November 11th, the output had dropped to 850 pounds in 15 to 18 hours on a charge that had formerly produced 11 to 1400 pounds of iron in 12 hours. Porteous wrote that he told Adams, "I could run the furnace just as well as he could, and so I can, but I have no wish, if he does what is right."[24]

Throughout these difficulties, and while encountering outright hositlity from Adams and the Thompsons, Porteous continued to experiment with the furnace. On the 11th, he removed the seven pounds each of lime and traprock from the charge, leaving the clay and lime as the fluxing matter. The move seemed to help a little, he reported. But the problems had now gone on too long - the supply of charcoal had been completely depleted - and on the 13th of November, Porteous blew out the furnace.[25]

The first blast had probably lasted about seven weeks, and could not have been called a success. Even in the mid-1840s, most furnace campaigns lasted for more than seven weeks, with six months seeming to be an average figure. But for the first time, the problems seemed traceable to people, not the ore. Porteous believed he had found the way to run the blast - turn it down when the top raged, and then work it up slowly. But Adams had merely blown full tilt, burning ore and charcoal while producing little iron. Henderson and Porteous believed part of their difficulty stemmed from the deterioration of the boshes - the widest part of the furnace. But inspection showed very little wear at that point. The difficulties could be traced in large part to the overstrong blast.

The year had not been a total waste, however. The furnace had run 90,788 pounds of plate metal, which gave a low daily average, even for an 1840s furnace. But this output almost certainly represented a larger quantity of iron than had been produced in the previous 12 years of effort. Moreover, Porteous had accomplished a number of other projects besides the furnace. The carpenters had improved and secured the dam at Lake Henderson, and added a new dam, flume, and water wheel with bellows to the works. Other new structures included houses and a large charcoal kiln. Henderson summarized the year in this way:

> The operators at Adirondack this year, although <u>vexatious and expensive</u>, have yet fully proved - that the ore will run regularly that valuable white metal - the furnace being in order - that

> metal can be regularly made - into an extraordinary for its quality. The fact of quality is most certainly and satisfactorily proved . . .
>
> What is now wanted - is - above all good workmen and a thorough system of operations.[26]

While the furnace had occupied much of Porteous's time through 1844, other tasks and duties continued to demand attention as well, such as arranging for supplies like food, firebrick, a scale, and writing paper. Crews at the works had to be detailed to cut cordwood for charcoal, mine ore, and saw limestone at Newcomb Lake. Carpenters began a new coal house between the furnace and the charcoal kilns. They also built a frame shed around the wooden blowing tubs and regulator. Porteous put others to work sawing planks, repairing the roads, threshing oats, and covering the pump logs carrying water to the tuyeres. He also eyed a scheme to build a lift to the top of the charging bridge from the factory house. Taking power off the stamper shaft, he could hoist ore this way, saving the expense of a team.

Another new installation to be planned was a cupola furnace. The owners desired to produce castings with this equipment, rather than ladle the iron out of the furnace into moulds. The cupola simply remelted the pig iron from the blast furnace, which then was run into sand moulds. For their cupola furnace, they intended to use boiler plate to form a shell eight to nine feet high, lined with circular fire brick to form a 24-inch opening. Some 4,000 to 5,000 more firebrick and eight barrels of fireclay were needed to complete the construction.[28] Finally, Porteous resolved the Adams affair by firing him, writing that, "I. . . I never, if I had ten furnaces, would ever have him as anything but an under hand, and then I would not care much of having his services on any price."[29]

Porteous also had to devote time to overseeing the operations at the forge. With the furnace producing iron, activity in the foundry house shifting from the production of blooms to the refining of the pig into bars of wrought iron. In other words, the bloomary forge became a chafery. Having been out of use for almost a year, the forges first needed repairs. The partners arranged for a Mr. Sharpe to run the fires, starting about November 1st. He agreed to produce only perfect bars, for $16 a ton. Out of this, Ferguson, who served as hammerman got $7 and he in turn paid $2 to the heater. As usual, the price was higher than elsewhere - similar work in Connecticut only earned $12 a ton. But the forge operated quite smoothly, after Sharpe recovered from an initial illness. The bars were sound and solid. A blacksmith tested them and pronounced the iron excellent. Henderson hoped to get 20 tons refined over the winter, with Sharpe working 750 pounds a day. All the forge required was a yet heavier hammer, with a new helve, collar, cam, and gudgeons. With the small hammer for drawing the bars, and a heavy one for shingling, the forge would be well equipped. By the end of March, Taylor the millwright had added the necessary water wheel to power the new machinery.[30]

Despite the problems with Adams and the furnace, the works by early 1845 appeared to have reached an equilibrium and stood on the verge of becoming a truly going concern. Henderson captured this sense of confidence and expectation of success when he told McIntyre in December, 1844, that the experiments had come to a successful conclusion. All that the company had to do now was run the furnace week in and week out and make iron.[31]

## Notes

1. McIntyre Journal, 9 October; 16 October, 1843, MS 65-28, Box 6; Henderson to McIntyre, 25 October; 1 November, 1843, MS 61-62, Box 1, Folder 4; McIntyre to Porteous, 30 October; 3 November; 17 November, 1843, Folder 2; Hammonds & Co. to Porteous, 15 November, 1843, MS 74-18, Box 1, Folder 9.

2. McIntyre to Porteous, 14 November, 1843, MS 74-18, Box 1, Folder 2; Henderson to McIntyre, 10 November; 15 November; 20 November, 1843, MS 61-62, Box 1, Folder 4.

3. Henderson to McIntyre, 30 December, 1843, MS 61-62, Box 1, Folder 4.

4. McIntyre Journal, 21 October, 1843, MS 65-28, Box 6; Henderson to McIntyre, 15 November; 18 December; 25 December; 30 December, 1843, MS 61-62, Box 1, Folder 4.

5. Henderson to McIntyre, 20 November, 1843, MS 61-62, Box 1, Folder 4; McIntyre Journal, 16 October, 1843, MS 65-28, Box 6; Henderson to McIntyre, 20 October, 1843, MS 61-62, Box 1, Folder 4.

6. Henderson to McIntyre, 20 November, 1 December, 1843, MS 61-62, Box 1, Folder 4.

7. Henderson to McIntyre, 1 December, 1843; 3 January, 1844, MS 61-62, Box 1, Folder 4.

8. _Ibid._, 1 December, 1843.

9. _Ibid._, 3 November, 14 November, 1843.

10. _Ibid._, 20 November, 1843.

11. Actually from the re-starting of the works, Henderson deserved this designation, which Henry Dornberg, a long-time employee, gave to Henderson. Henry Dornberg, "Why The Wilderness is Called Adirondack," (Glens Falls, 1885), p. 1.

12. Henderson to McIntyre, 1 December, 1843; 29 January; 5 February; 4 March; 27 February, 1844, MS 61-62, Box 1, Folder 4.

13. _Ibid._, 10 July; 16 July, 1844.

14. _Ibid._, 27 February, 1844.

15. Henderson to McIntyre, 16 May, 20 May; 15 June, 1844, MS 61-62, Box 1, Folder 4.

16. Frederick Overman, The Manufacture of Iron in all its Various Branches, (Philadelphia, 1850), pp. 428-442, offered only one of many summaries of the development of hot blast. Significantly, Mushet not only mentioned it, but provided plates that illustrated the construction of this apparatus. David Mushet, Papers on Iron and Steel, (London, 1840), pp. 252-4, 925, Plate VI. Photo 1 shows an 1846 sketch by Cole, depicting the furnace and village.

17. Porteous to McIntyre, undated letter number 5, ca. 15 Ocotber; 18 October; 22 Ocotber, 1844, MS 74-18, Box 1, Folder 1. Henderson to McIntyre, 26 October, 1844, MS 61-62, Box 1, Folder 4.

18. Porteous to McIntyre, 1 November, 1844, MS 74-18, Box 1, Folder 1.

19. Ibid.

20. Ibid.

21. Ibid.

22. Ibid., 7 November, 11 November, 25 1844.

23. Ibid., 7 November, 1844.

24. Ibid., 11 November, 1844.

25. Ibid., 11 November, 12 November, 15 November, 1844

26. Ibid., 12 November, 3 December, 1844; Henderson to McIntyre, 22 November, 18 December, 6 December, 1844, MS 61-62, Box 1, Folder 4, 11 January, 1845, MS 61-62, Box 2, Folder 8. Photograph 2 showed the type of dam built at Adirondack.

27. Henderson to McIntyre, 22 November, 26 November, 1844, MS 61-62, Box 1, Folder 4; Porteous and Robertson list, undated, MS 65-28, Box 4, Misc. Papers.

28. Porteous to McIntyre, 1 November, 11 November, 15 November, 27 November, 1844, MS 74-18, Box 1, Folder 1; Note in McIntyre's hand, undated, MS 65-28, Box 4, Misc. Papers. The remains of the cupola are still visible.

29. Henderson to McIntyre, 22 November, 1844, MS 61-62, Box 1, Folder 4; Porteous to McIntyre, 24 November, 3 December, 1844, MS 74-18, Box 1, Folder 1.

Notes

30. Porteous to McIntyre, 18 October; 1 November; 11 November; 24 November; 27 November; 3 December; 21 December, MS 74-18, Box 1, Folder 1; Henderson to McIntyre, 1 January; 14 March; 29 March, 1845, MS 61-62, Box 2, Folder 8.

31. Henderson to McIntyre, 18 December, 1844. MS 61-62, Box 1, Folder 4.

## CHAPTER V

While Henderson might have thought the experiments were over, the actual operations and activity in the village of Adirondac did not settle down to merely producing iron. With a covered wheelhouse that prevented ice from stopping the wheel, the forge ran all winter and by the end of February, 1845, seven tons of iron had left the sheds for Crown Point, with more ready to follow.[1] But the primary target for attention remained the blast furnace. Almost as soon as Porteous stopped the furnace, the partners began considering increasing the height of the stack by five feet, and adding a foot in width by removing and rebuilding the lining. Henderson offered some rough calculations on what they might expect as a result of enlarging the furnace. He guessed that a reasonable output might be 36 cwt. a day, or 10 2/3 tons a week. But to be safe, he figures eight tons a week with a 40 week campaign. The cost stood at $50 per ton by the time the Adirondack refined iron reached New York City. The bars, though, could sell for $90 to $100 per ton. The $50 per ton profit meant an income of $16,000, enough, Henderson guessed, to cover all conceivable expenses.[2]

With little hesitation, the partners laid plans to alter the furnace. The fascinating point about this effort was how they went about making the technical decisions involved in such a building project. None of the partners were iron makers. Porteous had gained the most experience, but was still a novice. So the works manager turned for help to the nearest iron works operating on a similar scale, the Port Henry Company. In 1844, Jonas Tower, supposedly one of the most noted furnacemen in the country, ran one of the Port Henry Company's pair of furnaces. Tower met with great success, providing 35-40 tons of iron a week. He stopped that furnace in late November, and blew in the older one there with the same results, raising its output from 21 to 35 tons a week. Tower very shortly joined with C. F. Hammond and Allen Penfield in Crown Point to form the Crown Point Iron Company, where he also proved very successful making iron, producing an average of 3,500 tons of iron annually. In 1852, Tower sold his share of the Crown Point Company and left. The point was that Towers knew furnaces - built the first Crown Point furnace in 1845, and knew how to make iron.[3]

During the winter of 1845, Porteous was in contact with Tower, saying, "I think I may learn something in conversation with him." Porteous had ordered new hot blast pipes from the Port Henry works, so he planned to visit Tower. He hoped to get Tower's ". . . ideas of the benefits to be gained and his idea of certain causes taking place damning the working of the furnace. He says he is willing to give me all the information he can..."[4] Tower did indeed give Porteous a great deal of assistance during the early months of 1845. Tower provided the plan used for latering the furnace. The Port Henry iron master wrote to Porteous, "I think you will find an excellent set of pipes that you get from here. I have taken great pains in the selection of iron and moulding and casting them." Tower also concerned himself with locating an iron master for the Adirondac furnace. A man who had worked for Tower, "an excellent keeper" headed the list. Tower even volunteered to come into Adirondac and help oversee the start of the alterations.

> Since you were [sic] here Mr. Canaan has been here, who says if I will go with him to your place and start your furnace for him he will take charge of it, by having two raw or inexperienced hands as keepers for him. Mr. Canaan is an excellent keeper and has kept for me at this place - and I have no doubt but he would do well with your furnace after it is started and well under way. I am not certain that I could go with him but think perhaps I might go and give directions to have your stack raised and heating apparatus put up in good order and hearth right, (as I suppose you intend to have done as you are getting new pipes) and then when you was heated up I might come and stay a week or ten days with you and get you well underway. I have got a set of pipes to put up here and an oven to build and I could bring my mason that helps me here and he would know how to put one up there without my being with him.[5]

Without this kind of assistance from someone who really knew the business, the furnace alterations would have taken far longer, if they could have been done at all. Just as Mr. Jackson at Port Henry had helped initiate the furnace, Jonas Tower facilitated the alterations. When considering the dissemination of new technologies and processes, historians should never overlook the personal contacts between trained and skilled technicians, even from firms that could be said to be competitors. Jonas Tower's involvement with the Adirondack Iron Works serves as a graphic example of the importance of such contacts.

By the first of April, 1845, the work of raising the stack had begun, and a month later the masons were installing the hot blast pipes. Tower had also rearranged the plan for the stove to heat the blast. Initially, the stove appeared to have been located on the ground, between the blowing tubs and furnace. A separate wood fire heated the pipes. But from the sound of the alterations, the new hot stove blast sat atop the furnace, using waste gases for heat.[6]

About 15 May, Tower arrived from Port Henry for the commencement of the 1845 campaign. Ten days earlier, fires in the furnace began to dry the new masonry. But Tower, for all his ability, could not master the Adirondack Company's ores. Porteous, writing to Tower two years later, recollected that, ". . . I told you that you should be well paid if you would come in and apply your invention with success at the furnace here. You did come and failed."[7] Tower and his furnace keeper then left, and Porteous was left to restart the furnace by himself.

Porteous tried again, starting the blast on June 1st. With Archibald Thompson and James Johnson as firemen, and Alexander Thompson and David Gates as helpers, Porteous returned to the previous year's methods. His efforts paid off, for right away the yield reached 10 to 12 cwt. of "excellent metal". For Henderson, this proved the value of running the place without an expert tender, for he believed that experience had proved that no founder would listen to their experiences with the "peculiar ore."[8]

The furnace began to improve, and the alterations must have been the reason. On June 14th, the furnace ran 15 cwt., the largest single day's total, and the week saw the total reach eight tons of white metal. On the 17th, a new record, over 2,100 pounds, was tapped from the furnace, eclipsing the single run record. That week ended with over 10 tons of iron produced. The furnace also used very little fluxing matter - 5% lime and the same of quartz sufficed. The contrast between the reign of David Adams and 1845 stood out sharply. The furnace had steadied down so that for the last three weeks of July, output was 35 1/2 tons in 21 days, and improving. Porteous made no mention of having to shovel the slag and cinder out of the hearth, a complaint Adams had made repeatedly. Henderson, again at Adirondac, believed that the workers constituted a factor equal in importance to the alterations, in explaining this yield:

> None of the men we have as firemen, etc. - were ever near another furnace or knew anything about the business; except what some of them learnt when we were going on last year; - and they therefore work as directed.[9]

The combination seemed successful, leading Henderson to speculate that a weekly output of 12 to 14 tons might be reached. This figure would still have placed the Adirondack Company's furnace below the average output 300 to 450 tons a year and three tons a day. The important contrast was the one made by Henderson, who observed that the Adirondac furnace was only 1/5 to 1/6 the size of many blast furnaces, at about 25 feet high with a seven-foot bosh. When the campaign ended, about August 8th, the furnace had run for 10 weeks and probably produced approximately 100 tons of iron. The results indicated where this furnace stood in relative terms. One might examine the production figures of Jonas Tower's furnace at Crown Point, which first ran iron on January 1, 1846. The company pushed for long runs, and produced about 3,500 tons of iron a year, in a furnace twice the size of the one at Adirondac. Especially with the use of a hot blast stove, the furnace at Adirondac should have done better. Clearly, problems still remained in the actual production of iron. Even though Porteous did not mention it, the problem of a slag that had to be shoveled, and would not run out of the furnace was the culprit.[10]

The lull in the furnace activity this time did not last long. The tymp stone, a large block that closed the crucible on the hearth side, had slipped and obstructed the opening used by the furnacemaster to observe the furnace. This chilled the box of the hearth, so Porteous had to stop and make repairs. Firestone from near Lake Delia proved quite suitable, and sometime in early September, furnace operations resumed, with a completely new hearth of large stone blocks - almost certainly of close-grained sandstone.[11]

While the furnace again occupied center stage, for Henderson especially, the general manager still found himself wrapped up in numerous other activities. At the works, he masterminded plans to improve the refining process. Specifically, this involved erecting the much-discussed puddling furnace for a trial. Not only did puddled iron offer improved consistency of bars, but the abundant spruce fuel around the village could fire the furnace more cheaply than the charcoal for a forge. Henderson also believed puddling presented advantages in terms of labor: ". . . good puddlers could always be more easily got than good lumbers."[12] By mid-June, the puddling furnace itself stood ready for trials, but two holdups unfolded. Taylor had had great difficulty getting in the necessary castings for the drawing hammer - apparently the cupola had not been erected so the castings could not be made at Adirondac. Worse, the puddler from Jersey City left the works, giving a pledge to return, but did not. A greater difficulty concerned the inability to fuel both the forge - for drawing the puddled bars - and the furnace simultaneously. Things rested in limbo by the end of August, with Henderson ready to postpone any effort at puddling until 1846.[13]

Other activities during this period included erection of another brick charcoal kiln to eliminate the charcoal shortage. Three double houses went up, and Lake Champlain brick makers came in to try the clay, but met with little success. Porteous had 20 hands, including eight Canadians, chopping wood. Twelve more men had to be found when it came time for winter hauling. Three Englishmen worked at raising the ore. All told, Henderson counted 85 people at the village.[14]

Henderson commented that the works and village were "now upon a better footing and more satisfactory than heretofore." And on other fronts as well, Henderson's description had bearing. The encouraging furnace results relative to 1844 fueled the fires of the old dream of a sale to capitalists, so that the company initiated another effort to attract the attention of English investors. David Colden, a Jersey City resident closely involved with Henderson and McIntyre and a member of the 1836 Redfield expedition, had heard from a Mr. Gilland in England that conditions there were very favorable for a sale. The last effort had taken place in 1840, backed by Emmon's pamphlet, without success. Colden had worked on that attempt as well. Henderson held out little hope of inducing a purchase. "I gave my opinion that it would be impossible to give any description to English Capitalists which could make them understand what Adirondac really is, or its great capabilities for large operations."[15]

Henderson only hoped that a sufficiently interested English buyer might send a representative to inspect the works. With this goal in mind, Henderson prepared a full article for Colden, gave him samples, promised a 10% commission to ensure full exertion, and watched Colden depart. The only snag that surfaced was a problem with the charter granted in 1839. Apparently, no formal meeting had ever taken place and the charter was permitted to lapse. An effort to pass a renewal failed when the legislature insisted on a clause calling for personal acceptance of company liabilities by the owners. This oversight emerged as a potentially significant problem that may have scuttled the chances of a sale.[16]

But the charter mattered little unless Colden could interest English iron-movers. Even here, the Adirondack Iron and Steel Company finally enjoyed some success. Colden had an interview with Sir John Guest, whom Henderson called one of the largest iron-makers in England. Henderson's appellation was not an outrageous exaggeration. Sir Josiah John Guest was manager of the Dowlais Ironworks near Myrthyr Tydvil in Wales. As shown by Henderson's early dream of constructing a large iron works, "like Merther Tydal" at Adirondac, the fame of the Dowlais Ironworks was widespread. Guest himself accounted for much of that fame. In 1815, he assumed direct control of Dowlais, having become, "thoroughly conversant with the details of the manufacture of iron." Guest implemented a number of changes, trying improved blowing engines, substituting raw coke for coal, introducing hot blast, successfully attempting to roll heavy rails. With the progressive leadership, the output increased from its 1806 level of 5,000 tons to 100,000 tons by the 1840s.[17] So Colden truly had chosen a most important figure in the British iron industry to speak about the Adirondac facilities, but Guest later bowed out of consideration.

A more promising situation developed out of Colden's discussions with the Bairds, a Scottish iron family. Like Guest, James Baird ran a major iron operation. His family had controlled coal fields in Scotland at Dalserf, Merryten, and Airdie. But he added iron property, and built furnace in 1830. By 1842, 16 furnaces were in operations, as Baird embarked on a major acquisitions program, purchasing coal and iron works in Lanarkshire, Ayr, Stirling, Dumbarton and Cumberland counties. By 1864, this empire embraced 40 to 50 furnaces, 10,000 men and boys, and 300,000 tons of iron annually. Baird was exactly the kind of expansionist-minded iron master whom the partners wished to interest in the Adirondack Iron & Steel Company. Colden, moreover, talked to Baird during a time when Baird was actively expanding his holdings, and the Scottish iron magnate did express an interest in Colden's presentation. Baird thought of sending out an agent, and even wrote to a Jersey City friend for a reference about the firm. As Henderson observed, "Colden at least deserves success - for he has laid seige to the largest iron master in England - & the largest in Scotland."[18] But while Baird remained interested, no mining engineer was available for the inspection trip, so hopes for a sale dimmed.[19] But the reception had been encouraging.

Henderson watched the efforts to sell the company from the sidelines. But he had no such passive role in efforts to push the company's product into the limelight of the American market. The year 1845 seemed like an excellent time to gain acceptance for the Adirondack iron, for the economy had finally recovered from the late-1830s depression. Prices were rising, the tariff continued in effect, and English capital had again become fairly abundant. One precept stood foremost in the minds of both Henderson and McIntyre as they began to envision quantity production. They retained the idea they had developed from the start, and which Emmons had enhanced, that the Adirondack Iron & Steel Company sold only high-quality iron, a special quality iron. They identified their competitors not as the English producers, but iron firms from Russian and Sweden. All they needed to do, the owners thought, was place their iron in the hands of some users of trials, and a market would quickly develop as the product's excellence gained itself a reputation.[20]

Henderson arranged with a New York City iron house, Wetmore & Company, to handle the distribution. The company agreed to sell the refined bars in small lots to as many machinists as possible at a price of $6 per cwt. Wetmore & Company was "a very respectable & safe house, and do a very large business in retailing by the cwt or ton to the machine shops . . . no house could give it wider distribution." Within two days, bars had already gone out for converting into blister and cast steel.[21]

Henderson had another plan to prove the superiority of the Adirondac iron. As soon as he had received the first refined bars from the furnace pig iron, the Jersey City owner considered sending the bars to a government armoury for testing. Colonel Totten, head of the Army Corps of Engineers, acted as intermediary for Henderson, and early in 1845, Colonel George Talcott, Chief of Ordance, wrote to Henderson specifying the type of iron required. The physical tests eventually took place during August at the Springfield Armoury in Massachusetts on six or eight bars of refined iron.[22]

Henderson had the most sanguine expectations about the results of these tests, as seen in this comment about the Armoury trials. "Should the iron be found to be first rate for gun barrels - and better than any they have had - we could take an order and go on with it this ensuing summer." Unfortunately, the iron did not match with the hopes of the partners. The key difficulty remained consistency. Wetmore had sent two or three bars to Rodman's machine shop, and one turned out bad - ". . . it had been burnt they thought in the heating and it was deficient in tenacity when drawn at red heat." Yet Rodman had manufactured nuts from the other bars, ". . . a severe test." By the end of July, the Rodman story had been repeated several times, as at the New Jersey Railroad shops, which received a bar good on one side, but bad on the other. These difficulties probably explained the desire to try puddling the pig iron, and the installation of the heavier tilt hammer at the works.[23]

The results of the armoury tests came as a far greater shock to the Company. The letter from Major James Ripley, the commander at Springfield, politely returned a memorandum and trial information from the Master Armourer, neither of which survive.[24] But they clearly contained bad news, as evidenced by Henderson's response.

> Neither the language not the writing of the Report nor the "stinking paper" as you call it upon which it and the letter accompanying is written, do much credit to the Major in the corresponding department of the Armoury

> at least. The best iron was the double marked which was piled- atho' they had no chance to pile it here, having been done in the forge while it ought to have been done in a heating furnace. To make iron as perfect as they want it, it should be piled twice perhaps - so as to get every impurity out of it by repeated heating and hammering. The report may be a perfectly honest one and we should not think otherwise, although it might be so. It makes me think no worse of the quality of the iron which our ores will make, but it convinces me of the great pains which would be necessary to make gun barrel iron.[25]

The difficulties encountered by the company even after the actual production problem appeared resolved must have fallen hard on the owners. Clearly production of a quality iron consistently required enormous efforts and constant attention to details. But the confidence to do this remained, as Henderson's tone clearly demonstrated. In fact, while pushing the various trials, he had returned to yet another old scheme for using the company's iron - the manufacture of steel. Steel production had long been stymied in the United States - in fact only the English had truly excelled at it. Only with the Bessemer process did steel finally become available in quantity anywhere. Henderson observed that no American iron had yet made steel of any value, although Dannemora iron, from Sweden, had been wrought into steel in the United States, apparently with the German forge process. Overman, writing five years after Henderson, made much the same point.

> In this country, there is no prospect of making steel directly from the crude metal, unless ores of a very different character from those we at present possess shall be discovered. Such steel requires those rich ores which contain magnanese; and these to all appearances, do not exist on this side of the Mississippi. It is possible that a kind of white pig metal, suitable for the manufacture of German steel, might be smelted from magnetic ore; but of this there is, at present, no prospect. Surely, this cannot be effected by hot blast, and so long as our furnace owners use such blast in the manufacture of steel metal, they will not succeed in producing a good article.[26]

But as always, Henderson had high hopes for the company's iron, hopes buoyed by comments of people trying their product. An Englishman in Pennsylvania had tried repeatedly to obtain their bars, after converting a sample into blister steel. That man told Henderson ". . . it was the only American iron which would answer the purpose." It appeared, then, that Henderson may have had some justification for his remark that "I will be every much mistaken if the Adirondack does not make as good steel as the best of the Swedish brands." The dream born with the very first loup made in 1832 remained alive. Henderson determined to prove their belief, and was pleased that Wetmore sent the first two Adirondack bars out for conversion into steel. He also arranged tests himself, as when he sent bars to a Philadelphia works for conversion to blister steel. The plant there usually worked with Swedish iron, but apparently found the Adirondack bars satisfactory. Encouraged, Henderson said, "We really should put up a cementing furnace at Adirondac which is a simple affair. We could convert it there from $3 to $4 per ton."[27]

Henderson had another fish on his line that he was reeling in, again related to steel production. About October, 1844, a Mr. Pickslay had expressed an interest in the Adirondack white metal for conversion into steel. Pickslay was a Sheffield steel maker, whose son lived in the United States. Samples sent to England convinced the steelmaker that Henderson's idea of converting the pig iron directly to steel might have merit. Those tests continued with samples from Adirondack, but apparently the one-step process did not work well. Still, Pickslay succeeded in manufacturing an excellent cast steel from Adirondack bar iron, using the steel in razors and pen knifes.[28] Here opened the path that Henderson wished to pursue, for while high-quality iron offered a good market; steel would be the pot of gold at the end of the rainbow.

The correspondence leaves little doubt that by the 1840s the guiding force behind the enterprise was David Henderson. His activities encompassed all facets of the iron company, from markets to production. Very large chunks of his time were spent at the village as he tried to smooth the operations. Yet at the same time, Henderson owned and ran American's first commercial pottery, in Jersey City. The American Pottery had pioneered the use of molds, in the English manner, for mass-production. As one historian observed,

> Their output from the very beginning was so different from other native wares and so much more sophisticated that we may well call Henderson the Wedgwood of America. Although not endowed with the fine artistic sense of his great predecessor, Henderson turned the course of potting in America, as did Wedgwood in England, away from the primitive traditional wares fashioned by individual craftsmen to ceramic forms that were created by professional workmen.[29]

Henderson also introduced transfer printing of decoration to American pottery. From his shop emerged a number of potters who later won acclaim for the excellence of their work. Critics of the time recognized the excellence of the American Pottery Company ware. In September, 1830, Franklin Institute presented a silver medal to the firm, while a month later the American Institute of New York awarded the company a first premium. Henderson had purchased the works in 1828, after they failed in the hands of the original owner. Within two years, he had turned the company around.[30]

The exact role of Henderson in the pottery's later period, after 1840, just is not known. Hendry Dornburgh, a long-time Adirondac employee said in an 1885 reminescence that "Mr. Henderson . . . withdrew from the pottery business after engaging in the iron and steel experiments . . ." But Dornburgh was not employed until about 1844, and his account at other points contained numerous descrepanices.[31] But it would have been difficult to manage two sizeable enterprises simultaneously, although McIntyre also did so. The point remains that Henderson proved a talented manager, an inquisitive technician, and a knowledgeable innovator who attempted to keep his business as technologically up to date as possible. Both the pottery and the iron works bore the evidence of his attentions. Outwardly, at least, the iron works appeared to be on a stable footing in 1845, thanks in large part to Henderson's guidance and administrations with Porteous. The death of David Henderson on 3 September, 1845, came, then, as a severe blow to the fortunes of the Adirondack Iron and Steel Company.

Like the account of the discovery of the ore bed, the accounts of Henderson's death have passed into the lore of the Adirondacks. The story has appeared in numerous places.[32] A severe drought marked the year 1845, drastically lowering the level of the Hudson River and Lake Henderson. Through August, only the sawmill ran, yet the lake fell to a depth of only six feet. Had the furnace or forge operated, the Lake would have been emptied. The key problem stemmed from the layout of the works. "We have a great and adequate water power for any desired purpose provided it is properly used at the different sites between the two lakes, but out whole works are on one site, comprising six water wheels, each drawing water which cannot be used by the others."[33] To deal with the water storage, Henderson planned to investigate an option mentioned by Emmons five years earlier, and known for six years before that. Just below Lake Colden on the Opalescent River, the Opalescent East Branch of the Hudson were separated by only a low ridge. The plan called for erection of a dam 33 feet long on the bottom, 50 feet across the crest, and 19 feet high to divert the Opalescent into the East Branch. On the 3rd of September, Henderson and a party of men set out to survey this dam site, with the intention of beginning construction immediately, while the water was so low. That evening, Henderson was killed by the accidental discharge of his pistol when the lock struck a stone, as the party made camp. He died shortly thereafter. From that time, the stream bore the name Calamity Brook, and the marshy duck-hole at that place was called Calamity Pond.[34]

Traditionally, the death of Henderson has been said to signal the death of the Adirondack Iron and Steel Company. Dornburgh's was only the most sentimental version of the impact of Henderson's untimely death upon the enterprise..

> Mr. Henderson was a sceintific man of more than ordinary attainments and was not only one of the best financiers but was very accomplished and agreeable. He was always very pleasant with his men and as he was an excellent

> violinist he often played while his men indulged in a little dance. This manifestation of interest in them won their friendship and his name will be reverred by them as long as life lasts. The day of the calamity still seems fresh with many . . . Had Mr. Henderson lived, in all probability, the Adirondacks would have flourished with iron and steel works second to none on this continent. His whole energy was in that direction.[35]

Such speculation will never solve any historical riddle. The fact remained that not only did the owners have to deal with the problem of inconsistently refined bars, but also the old transportation headaches. Henderson might have managed the former, but the latter difficulty continued to obstruct the hopes of men well beyond the demise of the Adirondack Iron and Steel Company. Certainly the historian would have liked to see Henderson live beyond 1845, for after his death, the quality of the letters declined, for no other owner possessed the desire for the minute detail that made Henderson's letters so valuable.

The greatest loss was his enthusiam, for no one could replace Henderson's interest, and the sense of confidence and leadership he brought to the enterprise. As Masten noted, McIntyre was 73 years old and not in robust health. Robertson lacked the ability and knowledge to run an iron works, and possessed business interests in Philadelphia that demanded attention. But the Company continued, as McIntyre reassured Porteous three weeks after the tragedy, "with bigor." Masten attributed the continuation to the built-up momentum of the enterprise. More importantly, one could cite the exertions of the people who assumed Henderson's duties.

Primarily, credit belonged to Andrew Porteous, whose contributions have long gone unrecognized. Others who assumed roles of importance were Henderson's nephew and namesake, and a group of individuals known as "the Nephews of the Company" by Dornburgh - younger cousins of McIntyre and Robertson.[36] For a while, the Company managed to stave off the great difficulty that faced all family firms - the transition from one generation to the next. In fact, the next ten years saw the works carried to their highest development. But as the letters betrayed, the confidence seemed gone after 1845, replaced by a grim determination to succeed. On September 1st, Henderson had written that the forge and furnace stood idle and the river empty to conserve water. "Although there are a great many men here scattered about at one kind of work or other - the furnace being stopt makes it dull, and Adirondac really does not look like itself . . .[37] Henderson's death had the same impact on the appearance of the village.

## Notes

1. Porteous to McIntyre, 3 December, 1844, MS 74-18, Box 1, Folder 1; Henderson to McIntyre, 1 January, 24 February, 1845, MS 61-62, Box 2, Folder 8.

2. Henderson to McIntyre, 6 December, 1844, MS 61-62, Box 2, Folder 8. These figures were not too far off base. Henderson in April quoted New York prices for various types of iron. Ordinary quality Swedish iron - $87.50; English refined - $92.50; Old Sable (produced in and around Au Sable, New York, then the best in the U.S.) - $110. The only point undetermined was whether the Adirondack iron matched these in quality. Henderson to McIntyre, 10 April, 1845.

3. Frank S. Witherbee, "History of Mining Industry," in Warner and Hall, (1931), p. 45; J. Disturnell, A Gazetteer of the State of New York, (Albany, 1842), p. 330; Barker, The Story of Crown Point Iron, pp. 7-9; R. Rodgers to Porteous, 6 December, 1844, MS 74-18, Box 1, Folder 9; Porteous to McIntyre, undated letter number 4, ca. December 8, 1844, Folder 1. Much of Tower's success may have stemmed from a patent he had taken out 7 December, 1844, for making a grout of the ore and a clay. By charging the wet grout into the furnace, Tower claimed that the furnace produced a more liquid iron and slag, and increased its output by 100%. James Hodge, "Iron ores and Iron Manufacture of the United States, New York," American Railroad Journal, Vol. 22:575-7, 591-5; Subject - Matter Index to Patents, Vol. II:78?, Patent # 3350

4. Porteous to McIntyre, undated letter number 4, MS 74-18, Box 1, Folder 9; Henderson to McIntyre, 29 March, 1845, MS 61-62, Box 2, Folder 8.

5. Jonas Tower to Porteous, 10 February, 1845, MS 74-18, Box 1, Folder 10. See also Henderson to McIntyre, 24 February, 29 March, 1845, MS 61-62, Box 2, Folder 8.

6. Henderson to McIntyre, 29 March, 29 April, 1845, MS 61-62, Box 2, Folder 8. On original hot blast stove see Porteous to McIntyre, 1 November, 11 November, 12 November, 1844, MS 74-18, Box 1, Folder 1.

7. Henderson to McIntyre, 5 May, 6 June, 1845, MS 61-62, Box 2, Folder 8; Porteous to Tower, 11 August, 1847, MS 74-18, Box 1, Folder 10. The occasion for the last was a letter from Tower to Porteous accusing the Adirondack Iron Works of using his patent without payment. The reply, drafted by McIntyre and sent out over Porteous's signature said that the patent was unjustifiable because the process had originated in Germany before Tower's patent. But they did offer to settle with Tower if demands were reasonable.

8. Henderson to McIntyre, 6 June, 1845, MS 61-62, Box 2, Folder 8.

9. Ibid., 14 June, 18 June, 4 August, 1845.

10. Ibid., 23 June, 4 August, 14 August, 1845; Barker, 1941, p. 8; Temin, p. 25; McGannon, ed., The Making, Shaping and Treating of Steel, (Pittsburgh, 1971), p. 9. James Hodge, "Iron Ores and Iron Manufacture of the United States; New York," American Railroad Journal, 22(October 13, 1849):639-40.

11. Ibid., Henderson to McIntyre, 14 August, 1 September, 1845, MS 61-62, Box 2, Folder 8.

12. Ibid., 14 June, 1845.

13. Ibid., 18 June, 4 August, 14 August, 1845; Henderson to Porteous, 4 August, 1845, MS 61-62, Box 1, Folder 3.

14. Henderson to McIntyre, 1 September, 2 September, 1845, MS 61-62, Box 2, Folder 8.

15. Ibid., 29 March, 1845.

16. Ibid., 7 April, 10 April, 18 April, 5 May, 19 May, 21 May, 1845.

17. Ibid., 12 July, 22 July, 4 August, 1845; Leslie, Stephen, and Sidney Lee, eds., The Dictionary of National Biography (London, 1949-50), VIII:763-4.

18. Henderson to McIntyre, 22 July, 4 August, 1845, MS 61-62, Box 2, Folder 8; Leslie and Lee, ed., (1949-50), I:918-9.

19. McIntyre to Porteous, 23 September, 1845, MS 61-62, Box 1, Folder 3.

20. Henderson to McIntyre, 10 April, 1845, MS 61-62, Box 2, Folder 8.

21. Ibid., 29 April, 1845.

22. Ibid., 29 November, 6 December, 1844; 1 January, 14 January, 14 March, 1845. The author wishes to thank Dr. Merritt Roe Smith of the Ohio State University for help in tracking down information regarding the Springfield tests.

23. Henderson to McIntyre, 14 January, 1 May, 30 July, 1845, MS 61-62, Box 2, Folder 8.

24. Major James Ripley to A. W. McIntyre, 25 August, 1845, "Letters Sent, February, 1835 to November, 1847," Records of the Springfield Armoury, Massachusetts, Series 1351, Records of the Office of the Chief of Ordinance, Record Group 156, National Archives Building.

25. Henderson to McIntyre, 1 September, 1845, MS 61-62, Box 2, Folder 8.

26. Ibid., 1 January, 1845; Overman, 1850, p. 467.

27. Henderson to McIntyre, 18 October, 1844, 1 January, 24 April, 1845, MS 61-62, Box 2, Folder 8.

28. Ibid., 18 December, 1844, 18 May, 19 May, 4 August, 1845; Henderson to Porteous, 4 August, 1845, MS 61-62, Box 1, Folder 3.

29. L.W. Watkins, "Henderson of Jersey City and His Pitchers," Antiques, (December, 1946):p. 388.

30. Ibid., see also Eaton, 1899, pp. 94-5; William Starr Myers, ed., The Story of New Jersey, (New York, 1945), p. 171; The Newark Museum, The Pottery and Porcelain of New Jersey, 1688-1900, (1947), pp. 9-10, 3[illegible]46; The Newark Museum Association, The Pottery and Porcelain of New Jersey, prior to 1876, (Newark, 1915), p. 21; Adeline Pepper, "New Jersey - Pioneer of American Pottery," The Royale Forum, No. 96 (September 15, 1961):11-14; and Margaret E. White, The Decorative Arts of New Jersey, (Princeton, 1964), p. 39.

31. Dornburgh, (1885), p. 8.

32. Ibid., pp. 5-8; Seneca Ray Stoddard, "Old Times in the Adirondacks, being a narrative of a trip into the wilderness in 1873," Stoddard's Northern Monthly, Vols. 1 and 3 (October, 1906 - May, 1907, August, 1907 - January, 1908), various pages; Masten, (1968), pp. 99-105; Paul Jamieson, Adirondack Reader, (New York, 1964).

33. Henderson to McIntyre, 1 September, 1845, MS 61-62, Box 2, Folder 8

34. Ibid., 2 September, 1845; Masten, (1968), pp. 99-104. As Masten and others have described, Henderson's family erected a monument in his memory that still stands at Calamity Pond on one of the trails to Mount Marcy in the High Peaks. Masten, pp. 104-5. A lumber dam, probably built near the turn of the century, still stands on the Opalescent where Henderson had planned to build their dam. As anticipated the waters of the Opalescent flow down Calamity Brook, as well as down the Opalescent River.

35. Dornburgh, (1885), p. 8. See also Masten, (1968), p. 109.

36. Masten, (1968), p. 113; Dornburgh, (1885), p. 9.

37. Henderson to McIntyre, 14 August, 1845, MS 61-62, Box 2, Folder 8.

# CHAPTER VI

After the shock of Henderson's death had worn off, McIntyre and Robertson moved to fill the void of managerial direction. There were several loose ends that required attention, so Porteous received a number of orders from the two surviving owners. The yearly repetition of worry over supplies surfaced in the letters. By Mid-November, McIntyre had already spent $2,296 on items ranging from 100 barrels of flour to 6,000 firebricks and an old boiler. Some 76,200 pounds of material soon waited at Crown Point for shipment into Adirondac. Porteous also had to attend to digging up clay for the manufacturing of bricks in 1846, and to detail crews to cut and haul large quantities of cordwood for charcoal. Robertson wanted timber cut for sawing at the mill, and a new bellows shaft readied from a pine log. Finally the owners abandoned all hope of bringing puddlers in during 1845. McIntyre was sorry about this decision, writing, "I am well aware of the importance of the conversion into bar iron of the furnace metal - but I dread mistakes and failure and think it therefore most prudent and safe, to run the furnace alone this season . . ."[1]

The furnace did continue to run, as McIntyre indicated. Henderson, just before his death, had written that Porteous had almost completed the repairs, and the furnace would start shortly. Probably his death forced a delay in that schedule, but Porteous probably did get the furnace into blast by the end of the month. The campaign lasted longer than either of the two previous blasts, for not until the end of the year did the need for additional repairs force another lull in furnace operations. Porteous had taken McIntyre at his word, for in November the older man advised Porteous to run the furnace as long as possible.[2] During 1845, the furnace probably worked for about 33 weeks. No figures have survived to indicate the output figures for the second campaign, but the lack of sharp complaints may indicate that production ran about as before, perhaps 11 to 12 tons a week. Both in terms of iron made, 250 tons, and in length of blast, the furnace stood far below national averages. But in relative terms the performance of 1845 outranked any other year.

The following year saw the continuation of most of the projects that had occupied Henderson's time. Moreover, the streak of little hard-luck incidents that always seemed to follow the works also continued. While in 1845, the refiner scheduled to run the tests at the small puddling furnace had left without notice and scotched these plans for a year. In 1846, the blast furnace developed more than its share of difficulties. These began in late 1845, when a load of firestone from Haverstraw, New York, got frozen in the Champlain Canal seven miles south of Whitehall. This exasperating delay halted plans to rebuild the hearth of the furnace. Some stone may have been hauled out of the boat and sent to the works on sleds, but the expense of that recourse limited how much stone could be sledded. Moreover, inspection of the furnace found that the heat had badly damaged the boshes, necessitating more extensive repairs than planned. Because of the stone problems, Robertson urged that Porteous use local stone for repairs, so as not to waste the whole winter waiting for the Haverstraw stone.

Once the need for extensive rebuilding presented itself, though, Robertson and McIntyre decided to enlarge the furnace again. One might question the sureness of Robertson's touch on technical matters, for earlier he had pressed Porteous to adopt a cold blast arrangement, a regression he felt would improve the yield contrary to all the accepted proof. The furnace rebuilding made far better sense. Robertson observed that, "It is altogether probable that if the furnace were put in good order even with its present capacity, it would do much better work than it has heretofore done, but as repairs have to be made, we certainly think, that its size should be increased at the same time, as much as is practicable in both breadth and heighth."[3]

The result of this decision pushed back the opening of the 1846 furnace operations until the end of June, for the material problems delayed the beginnings of construction work until early May.[4] But ample opportunities existed to keep Porteous busy. The primary additons the owners pushed forward were the puddling furnace and the cupola furnace. The cupola involved the least work. The partners had first considered erecting a cupola, which was used to remelt pig iron to make castings in large sizes, in the fall of 1844. They planned then to build an outer shell of boiler plate eight to nine feet high, lined with circular firebrick.[5] But nothing happened until Robertson picked up interest in the project a year later. Apparently to the old boiler sent up in November, 1845, was meant to supply the shell. By May, the cupola needed only its bosh and hearth. Later, Porteous wrote that he needed a large kettle able to hold 2,500 pounds of metal for large castings. Initially, they had hoped to use charcoal in the melting furnace, but other iron works almost exclusively used anthracite. Another iron works owner told McIntyre he would pay $50 a ton to get stone coal for his cupola. The result of that conversation was the shipment of five tons of Lehigh coal to the works. The freight charges to Albany alone cost $30. In the meantime, Porteous had borrowed coal from Penfield's forge in Ironville,[6] another indication of the close cooperation between Adirondac and other iron works in the region.

Robertson wanted the cupola built to provide castings for the other expansion project, the puddling furnace. "A very considerable amount of castings will be wanted very soon. Beside the heavy casting for the drawing hammer, which broke last fall, a great many plates for the Puddling Furnace will be required. It is important therefore that the cupola should be erected as soon as possible."[7]

The puddling works became the main project for the year 1846. Porteous started the year working the puddling furnace built the year earlier, but he reported the results showed the furnace was, ". . . not what it is cracked up to be." But the accounts of the puddling arrangements remain confusing, for although Porteous had erected some type of furnace in 1845, Robertson talked of building the puddling furnace in 1846. In February, 1846, Robertson wrote that the plans for the puddling furnace were not ready. Perhaps, the first furnace did not meet with their approval. Whatever, Porteous did build a reverbertory furnace based on a thorough set of plans provided by a man Porteous knew in Philadelphia. Robertson billed the plans as something special:

> The person who is to furnish it is desirous of having it very perfect, and for that purpose has been waiting for the result of certain experiments. You will want these specifications before you can cast the plates for it. The drawings and directions will be so complete, he informs me, that any mason can put up one from it.[8]

As the plans have survived, dated March 2, 1846, it turned out Robertson was not exaggerating. The plans were very thorough - with only the drawings missing now - and described a reverbertory furnace with a bridge 11 3/4 inches above the sole, using wood for fuel. The bottom consisted of cast-iron plates covered by forge cinders. The charge was 450 pounds, in 25 to 35 pieces. All interior masonry was firebrick, but the designer specified a shell of common brick tied together by wrought-iron anchors and bolts and cast-iron face plates.[9]

Porteous definitely followed these plans, assisted by a puddler and refiner sent up by Robertson, named Rufus Barney. Barney also tried his hand at the chafery before the puddling furnace was ready. By mid-May, the newest attempt to produce consistent iron was ready for testing. Initially, as might be expected, Barney had to work the bugs out of the new equipment. But things just did not go well. Robertson had counted on using Barney and his brother to work the reverberatory furnace around the clock.[10] It was not clear if this intention came to pass.

What did come about were problems with a big loss of iron in the refining process. Actually, this waste occurred in most all puddling furnaces. The benefit of the reverberatory furnace lay in the separation of the fuel and the iron. Only the heat of the fire was reflected onto the charge of pig iron. As it heated, the iron boiled, as the carbon left. The puddler had to stir, or rabble, the iron to promote this refining process. As the iron was purified, it became more pasty and was formed into a lumpy ball of metal that had to be hammered, or rolled into bars, for final refining. Compared to the chafery, puddling production of iron gave both a larger quantity and more consistently high-quality refined iron, despite the problem of loss. The change from a sand bed to iron bottom usually helped to limit the loss. But the furnace designer had led the owners to expect only an 8% wastage, so when the loss of Adirondac hit 38%, McIntyre became truly concerned.

> But I am very much astonished to learn of the great waste of metal in the conversion of pig into bar iron. I am very ignorant on this subject, but I never thought that the waste was half what you say it is. What do the Puddlers say on this Lead?[11]

Yet the furnace did turn out a sound quality iron, and McIntyre could not complain about that. His concern remained, as always, the production of high quality iron. "We must have our puddled iron, of the best quality, if possible, cost what it may, and therefore if the consequence of a decrease in the loss of metal be the production of an inferior quality of iron, the idea of an increase of quantity of bar iron in that way must be abandoned."[12]

McIntyre really had become obsessed with quality, for in this goal he saw the way of attracting attention to the works. In July of 1846, he wrote to Porteous emphasizing that point.

> . . . I am decidedly opposed to making the honey comb metal [bad castings] into blooms and setting them in Troy. What would be the consequences? They would have to be rolled for horse shoes or some other form, and if found bad, the reputation of Adirondac iron would suffer severely. No iron ought to be sent anywhere for sale from Adirondac, if we can help it, without being good. Instead of what you propose, I advise that this must be heaped out of the way, until some convenient time to work it up for our own use about the works. Or, may it not be well to prepare a load of blooms and send them to (in the winter) Clintonville to be rolled into loop (hoop) iron or some other form for use at Adirondac? that is, if found good enough for that purpose.[13]

From the quality viewpoint, puddling offered the best method of refining the iron, a fact McIntyre appreciated. Moreover, although Porteous had problems with the puddlers, he did not experience any difficulties with the puddling furnace. The furnace ran, on and off certainly, through 1846 and 1847. In the best Adirondac tradition, Porteous experimented with various additions to the fire to deal with the waste problem. And significantly, McIntyre had obtained the ideas on what to add to the reverberatory furnace through his reading:

> I have recently been reading all the articles I could find on late improvements in the manufacture of iron. When I have a little leisure, I will communicate to you what I know, and make such suggestions as I may deem useful. In all the articles I have read, manganese is considered important in improving not only the quality but the quantity. Mr. Robertson ordered a parcel of that from Philadelphia. It has not yet come on. When it does I will forward it with the other goods. If by using a small quantity of this article in the puddling process, the frightful waste of metal which we are now subject to, can be corrected, it will be exceedingly important.[14]

McIntyre read that the addition of 42 pounds of manganese, 14 of charcoal, 8 plumbago (graphite) and 2 saltpetre over the course of the refining improved the ore. The tests still continued a year later, when on five trials of 350 pounds each, the puddler, no longer Barney, produced a total 1,163 pounds. This gave an average yield of 232.6 pounds, indicating a 33.7% loss.[15]

The experimental, if not scientific, approach to problem solving continued to guide much of the activity at Adirondac. Porteous, having got the blast furnace back into operation by mid-year, 1846, had found that flint, or silex, worked well as a fluxing material to promote the formation of slag. Also, McIntyre directed Porteous to try the same addition to the furnace that was recommended for the puddling furnace. By and large, however, the furnace seemed to have been run much as always. The same comment would have been true of the puddling furnace, once the general pattern of operation had established itself. The length of the blasts through 1846 and 1847 cannot be determined from the sketchy letters available. The July, 1846, blast may have lasted through November when Porteous reported that the furnace was working better, although there probably had been an interruption between those times.

The only indication of production came from Henderson's nephew in Jersey City, who wrote that by late November, 1846, he had received 150 tons of iron from Adirondac. Almost certainly, this iron was refined bars, and no doubt from pig produced in 1845.[16] The only furor about the furnace in either 1846 or 1847 occurred when Jonas Tower, the formerly helpful advisor to Porteous accused the works of patent infringement on his grouting process. Porteous agreed that he did use a grout to charge the furnace - the ore being mixed with a wet clay - but argued that this could not be construed as infringement. First, Tower had tried it and failed, secondly, the process had come into use in Germany before Tower's patent had been issued. Still, Porteous and McIntyre offered to settle with him, if reasonable. Just how David Henderson the younger, who visited Tower, resolved the case was not related.[17] Apart from this incident, the correspondence, although far from voluminous for this period, indicated the development of a routine of sorts in the actual manufacturing processes.

The already established routine of the works also continued with the years barely distinguishable from one another. Porteous had his hands full, as usual. In 1846, he probably erected the ill-fated dam on the Opalescent, cut saw timber, made bricks - scouted a potential koalin bed for fireclay. On schedule in the fall, he worried about 150 barrels of flour and 60 barrels of pork, six half barrels of beef, 20,000 firebrick and ten barrels of clay - 40 tons in the last two items alone.[18] The same pattern followed in 1846, although the works ran out of flour by mid-year, necessitating purchases in Albany at twice the normal cost, with massive freight charges.[19]

The year 1847 did see several changes and additions to the works, all worthy of note. Clearly, Henderson's death had not stopped the continuing expansion of the enterprise. The first new arrival had been the appointment, at the request of the company, of a minister to serve the village. A Reverend Mr. Forrest duly appointed, arrived by late July. Unfortunately, he had great difficulty adjusting to adirondac. By mid-August, McIntyre wrote to Porteous, telling him that $25 would have to be the maximum credited to the preacher, who doubled as teacher. By September 2nd, McIntyre could say only this:

> I grieve for the unfortunate Forest. It was unfortunate he ever went to Adirondac; but as he is these benevolence forbids any other than kind treatment. He is as you say, no doubt, his mother's pet, and with her, I believe, he ought to spend his days.[20]

Forest apparently departed Adirondac shortly thereafter, but whether he followed McIntyre's advice is not known. The owners were, however, quite serious in their efforts to introduce organized religion to their settlement. As Porteous had written to one prospective bloomer in 1840, "We do not want men to put up with anything worse than they would in older settlements."[21] McIntyre and Henderson were both devout Presbyterians - Henderson delayed his departure for the iron works in 1845 so that he might witness the dedication of the new church in Jersey City. Their religious beliefs carried over into a legitimate concern for the welfare of their workers, especially for their religious well-being. In 1833, McIntyre wrote to Duncan McMartin, expressing genuine pleasure at the news that ". . . [with all your troubles] you have the satisfaction of having your people a little religious community." Even more satisfying was the discovery that the blacksmith Porteous hired was ". . . capable of officiating in a pious manner on Sunday and keeping the people together on that holy day." This spirit underlay the effort that brought Forest into the woods. David Henderson, just before his death, had mentioned that by 1846, 12 families would be living at Adirondac. "It is our duty to see that this settlement should not go on without the privileges of the Gospel. While it is our duty in a high sense, it is likewise in our interest."[22]

The owners's concern did go beyond mere altruism, as Henderson's last thought made clear. The company planned to allow the minister $100 a year for board, with an equal amount for teaching school, both during the day and in the evenings for the workers. Along with protecting souls, the minister could also protect the stability of the community. With the larger population that lived in Adirondac after the construction of the blast and puddling furnaces came more problems. The primary difficulty must have arisen from alcohol, as demonstrated by this letter from McIntyre to Porteous in 1846. ". . . You had there an abundance of appalling difficulties, but it seems that these have been increased, painfully and unwarrantly increased by intemperance. The resolutions early formed for keeping liquor from our settlement must be strictly adhered to so far as that can be done, and whenever it shall be discovered that any one violates this regulation, he must be instantly discharged."

Liquor was only the most obvious of the problems that confronted attempts to impose industrial discipline on workers. But as mentioned above, isolation eased these difficulties somewhat at Adirondac. Nonetheless, McIntyre remained keenly interested in efforts to deal with labor problems, as the company saw them. He avidly followed the published reports of how the Lowell textile establishments succeeded in their experiments, not only for any hints about running the iron works, but also to guide the efforts of the Auburn Woolen Factory Company, of which he was prime stockholder.[23]

Still, Adirondac seemed a reasonably placid place, where some workers remained for a fairly long period of time. The turmoil, perhaps, not surprisingly, centered around the higher skilled men, the puddlers and bloomers, usually not from the immediate vicinity. And these disputes almost always, as shown above, had wages at their center. At least, by 1846, Porteous was firmly seated in the superintendent's saddle, and no longer had to deal with challenges to his authority, as he had in 1839.

It would be hard to over-emphasize the isolation of the works as a factor in preserving a large measure of tranquilty at Adirondac. The roads, despite annual efforts by Porteous and the state, only merited that title in the winter, or late in the summer. In 1841, the state had passed the act to build the Carthage Road, which brought Surveyor Beach into the village that year. In 1846, the state had to pass a supplementary appropriation to permit completion of this line into the works.[24] Even that money had little impact on the depth of mud encountered in some of the bogs that the road traversed. Two different accounts of travelling into Adirondac offer some insights into how arduous a task a visit could be.

In September, 1843, McIntyre departed Albany with two companions, via the railroad to Saratoga Springs. Once there, they hired a carriage and made the 26 miles to Caldwell - present Lake George - before stopping for the night. The party resumed the trip the next morning, travelling via Warrensburgh and Chester, where they met Russel Root. Root kept an inn at Schroon River, and also did a great deal of teaming for the company, carrying supplies in from Crown Point. His was the last inn between the Lake and Adirondac. The travellers swapped carts and rode for 23 miles further with Root. Finally, on the third day out from Albany, McIntyre and company reached Adirondac after a 12-hour ride from Roots'.[25]

Three years later, a gentleman named Joel Headley paid a visit to Adirondac, the account of which he published in 1849 as part of a book, The Adirondack; or Life in the Woods. His entertaining description could probably have applied to many other trips.

> Well, here we are, in the heart of the forest, five of us bumping along in a lumber wagon over a road you would declare a civilized team could not travel. Now straining up a steep ascent - now a hang to the axle-tree between the rocks, and now lying out an angle of forty-five degrees, and again carefully lifting ourselves over a fallen tree, we tumble and bang along at the enormous rate of two miles an hour. By dint of persuasion, the use of the whip, and a thousand "he-ups", we have acquired this velocity, and been able to keep it for the last seven hours. . . . we at length, after forcing our way up the narrow and shallow inlet, found ourselves at the Adirondac Iron Works - the loneliest place a hammer ever struck in. Forty miles to a post office or a mill - flour eight dollars a barrel, and common tea a dollar a pound in the these woods, in the very heart of the Empire State![26]

But while transportation continued to offer an adventure to those willing to brave it, and headaches to Porteous when it came to supplying the works, other signs of permanence began to appear in the village. If nothing else, the arrival of the missionary from the Presbyterian Board of Missions signalled that the routine around the furnace and puddling works had settled into place. Another indication of settled existence appeared in the establishment of a bank in the side room of Porteous's cottage. The company felt that with a bank's ability to issue its own notes, they could more easily manage the shipment of money to pay the workers. So Porteous put up shutters on the cottage and strengthened the doors. Henderson shipped up a heavy chest as a safe, and in November, 1847, Henderson's nephew carried in $9,000 of McIntyre bank notes, $1,700 in specie and $50 in coins. The bank worked well, without any complaint from the workers about the bank's notes.[27] The only real change that the bank brought to the financial operations was a reduction in the amount of specie the company had to send north. Instead, the owners paid bills in the McIntyre bank notes that they ultimately had to redeem at the state treasurers. Only later did this arrangement develop into a headache in its own right.

The largest indication of the apparent stability of Adirondac came from the expansion program begun in 1847 at a site some 12 miles south of the village. This effort, centered on a site called the Lower Works, at the mouth of Lake Sanford grew out of Henderson and his partner's pre-occupation with the manufacturing of steel.

Throughout 1846, Henderson's nephew had maintained contact with Pickslay, the Sheffield steel maker, in an effort to close a deal whereby Pickslay used the Adirondack iron to make steel. By January, 1846, the Englishman wrote that he had succeeded in making 5 cwt. of steel from both the plate metal and the bar iron. The resulting products "have stood the severest tests to which cast steel is put, without failing in any one instance." Over the course of 1846, McIntyre arranged the shipment of 1,000 pounds, in 500-pound installments, to Sheffield for more tests. But it was only with the visit of Pickslay to the works in October, 1846 that plans for the production of cast steel at Adirondac began to emerge.[28]

Apparently, Pickslay remained in the woods for over a month, by which time, they had decided to push on with the construction of a steel works in 1847. McIntyre seemed quite surprised and somewhat leery of this new expansion effort.

> I did not know until I rec'd your letter of the 8th Nov. that Mr. Henderson and you had in view to make a trial of producing cast steel. I think it is probable that you might in the way you indicate make a 'pretty good article.' But the manufacture of a superior cast steel has commanded the attention of men of the first science and skill for very many years; and the conclusion that all have come to is, that a really superior

> article can only be produced from alleable iron, and that made at one particular place, Dannemora. Pickslay has now ascertained, however, "that Adirondac iron is fully equal and in some respects superior to that of Dannemora. This is very encouraging for us. He believes, moreover, that he has succeeded in producing first rate cast steel from the Adirondac cast metal. But still, as I believe, some doubts exist on this head. He has, no doubt made such, and can make it again, but will he be able to make it uniformly and constantly, or only occassionally.[29]

What bothered McIntyre equally was the question of location. The key determinant was a charcoal supply. Porteous had already been forced to make greater exertions to obtain fuel at the village. Building a steel works that planned to use charcoal would have overtaxed the area's ability to provide an adequate quantity. This fuel problem led to the decision to locate the steel plant downstream.

Very quickly, and with little hesitation beyond McIntyre's initial reticence, Porteous and the owners began to make arrangements to construct a major addition. By February 25th, Porteous had chosen a site, and clearing the trees had started. He decided to erect a dam, 600 feet long and 17 feet high, for water power to run the steel works and a saw mill. A kiln for charcoal also went up. Daniel Taylor, the millwright, guided the dam construction after Porteous hired him away from another job. An added benefit of the location chosen appeared when it became evident that the dam would raise the level of Lake Sanford enough to permit boats to run on the lake to within a mile of Adirondac. With roads like they were, such a situation came into immediate exploitation, and McIntyre urged Porteous to attend to the removal of any trees on the banks that would be overflowed to prevent later obstacles to navigation.[30]

The only puzzle about the work at Tahawus, as Pickslay called the Lower Works, after the Indian name for Mount Marcy, was that after such a fast start, the company never actually used the steel works, if indeed they actually built such a structure. The correspondence became very spotty after June, but in a September letter, no discouraging remarks were made. The probelms only surfaced in a letter written early in 1848 that mentioned a certain unwillingness on the part of Pickslay to be connected with the Adirondack Company. More confusing yet was a letter a day later from Henderson's nephew, saying Joseph Dixon was anxious to know if the company still planned to construct a steel works in Jersey City.[31]

Just what led to this drastic revision in plans after Setpember is not known. A good guess may be that Pickslay, who had not solved the riddle of producing cast steel from pig iron, using charcoal, backed out. One indication of problems with Pickslay's steel came from axes using Pickslay's steel, and sent to Porteous in January, 1847. McIntyre shipped more than two dozen axes to the works, but they were not good. Pickslay sent a second batch of two dozen bits to M. & S. Palton, a highly-recommended axe-maker, for a second try.[32] Perhaps these first indications warned the owners of potential difficulties. Whatever, between September and January, the owners, no doubt through the younger Henderson, established a relationship with Joseph Dixon to investigate the manufacture of cast steel in Jersey City, to safeguard against a failure by Pickslay.

Dixon proved to be another one of those fascinating 19th century inventor-entrepreneurs with wide, eclectic interests. Born in Marblehead, Massachusetts in January, 1799, as a youth Dixon cultivated an interest in printing, but could not afford metal type. As a consequence of mastering wood-carving to make wooden letters, he developed an interest in lithography. Also out of his interest in printing, Dixon experimented with crucibles in the casting of type. Through this work, Dixon found graphite, a material perfectly suited to crucibles. But facing a limited market for crucibles, Dixon turned to other uses for the material, like in pencils and stove polish. He opened a plant in 1827 to market these items, and continued experiments in lithography that in turn led him to photography. His experiments produced a number of patents, including a means of making collodion for photography, an ink to prevent currency counterfeiting, an anti-friction metal - perhaps babbit metal. In 1847, Dixon moved to Jersey City, where he almost immediately tied into the steel works. Neither Dixon's biographers nor the letters give any indication, but the coincidence of the Massachusetts inventor's arrival in Jersey City at just the right moment seemed strange. It would not be surprising to discover that Henderson's nephew or Robertson had enticed Dixon to New Jersey with an offer of employment as a steel works builder.

Ultimately, Dixon went on to found the Joseph Dixon Crucible Company, which became recognized as the leading American manufacturer of this product. The firm has continued in operation to the present day, successfully producing among other things, the two key products pioneered by Dixon - pencils and crucibles.[33]

Before January, 1848, had gotten too far advanced the company had come to terms with Dixon and signed a contract to have him build furnaces in Jersey City for the production of cast steel. Apparently, Pickslay had fallen out of the picture. Yet the arrangement with Dixon was not an instant occurrence, for the company's plans to hire Dixon were well-enough known to have attracted the attention of local iron companies interested in having their iron tried for cast steel. Moreover, another group had even approached Dixon, offering to establish him as superintendent in another cast steel plant. In Dixon, the Adirondack Iron and Steel Company possessed a highly talented technician. The company moved quickly to take advantage of his expertise.[34]

Notes

1. Account sheet, undated, ca. 15 November, 1845; MS 74 - 18, Box 1, Folder 5; Bill of lading for canal boat to Hammonds, 18 November, 1845, Folder 10; Memorandum for Mr. Porteous, undated, ca. late-1845, Folder 5; McIntyre to Porteous, 23 September, 1845, MS 61-62, Box 1 Folder 3; 13 November, 1845, MS 74-18, Box 1 Folder 3.

2. Henderson to McIntyre, 1 September, 1845 MS 61-62, Box 2, Folder 8; David Henderson (2nd) to Porteous, 13 January, 1846, MS 74-18, Box 1, Folder 8; McIntyre to Porteous, 12 November, 1845, Folder 2. David Henderson (2nd) refers to the original Henderson's nephew, who turned 21 at the end of 1844. As Masten noted, this young man watched his uncle's interests in Jersey City closely, and also involved himself with the general affairs of the iron works, although he probably had no official status with the management of the Henderson estate. Henderson (1st) to McIntyre, 1 January, 1845, MS 61-62, Box 2, Folder 8; Masten (1968), p. 111.

3. Henderson to Porteous, 13 January, 1846, MS 74-18, Box 1, Folder 8; McIntyre to Porteous, 9 February, 1846, Folder 7; Robertson to Porteous, 3 February, 1846, Folder 7.

4. McIntyre to Porteous, 30 April, 1846, MS 74-18, Box 1, Folder 4; Robertson to Porteous, 22 June, 1846, Folder 7.

5. Porteous to McIntyre, 1 November, 11 November, 5 November, 27 November, 1844, MS 74-18, Box 1, Folder 1; Note in McIntyre's hand, undated MS 65-28, Box 4, Misc. Papers. The shell of this equipment still exists next to the ruins of the 1844 blast furnace.

6. Robertson to Porteous, 14 February; 4 April; MS 74-18, Box 1, Folder 7; Porteous to McIntyre, 16 August, 1846, Folder 7; McIntyre to Porteous 9 June, 1846, Folder 4; Robertson to Porteous, 22 June, 1846, Folder 7.

7. Robertson to Porteous, 14 February, 1846.

8. Henderson (2nd) to Porteous, 13 January, 1846, MS 74-18, Box 1, Folder 8; Robertson to Porteous, 3 February, 14 February, 1846, Folder 7.

9. Puddling Plans, 12 March, 1846, F. Misc. File, McIntyre Correspondence, THS; McIntyre to Porteous, 18 March, 1846, MS 74-18, Box 1, Folder 4.

10. McIntyre to Porteous, 17 February, 1846, MS 74-18, Box 1, Folder 4; Robertson to Porteous, 4 May, 22 June, 1846, Folder 7.

## Notes

11. Peter Temin, Iron and Steel in Nineteenth-Century America, (Cambridge, Mass., 1964) pp. 18-91; McIntyre to Porteous, 22 December, 1847, MS 74-18, Box 1, Folder 5; 18 July, 1846, Folder 4.

12. McIntyre to Porteous, 7 January, 1847, MS 74-18, Box 1, Folder 5.

13. Ibid., 18 July, 1846, Folder 4.

14. Ibid., 25 February; 11 October, 1847, Folder 5; 3 November, 1846, Folder 4.

15. Ibid., 10 November, 1846, Folder 4; 22 December, 1847, Folder 5.

16. Ibid., 18 July, 1846, Folder 4; 10 November, Folder 3; 27 July, 1846, Folder 4; 24 November, 1846, Folder 1; Porteous to McIntyre, 28 September, 1847, MS 74-18, Box 1, Folder 1; Henderson (2nd) to McIntyre, 23 November, 1846; MS 61-62, Box 1, Folder 5.

17. McIntyre to Porteous, 7 January, 1847, MS 74-18, Box 1, Folder 5; Jonas Tower to Porteous, 11 August, 22 August, 1847, Folder 10; McIntyre to Porteous, 9 September, 1847, Folder 5.

18. McIntyre to Porteous, 17 February; 30 April; 18 July; 3 November, 1846, MS 74-18, Box 1, Folder 4; Robertson to Porteous, 22 June, 1846, Folder 7; McIntyre to Porteous, 10 November, 1846, MS 61-62, Box 1, Folder 3.

19. McIntyre to Porteous, 10 July; 26 May; 1 June, 1847, MS 74-18, Box 1, Folder 5.

20. McIntyre to Porteous, 2 July, 19 August, 2 September, 1847, MS 74-18, Box 1, Folder 5.

21. Porteous to Obadiah Eddy, 5 March, 1840, MS 74-18, Box 1, Folder 9.

22. McIntyre to Duncan McMartin, 16 July, 1833, MS 61-62, Box 2, Folder 10; McIntyre to Porteous, 16 March, 1839, Box 1, Folder 3; Henderson (1st) to McIntyre, 1 September, 1845, Box 2, Folder 8.

23. Henderson (1st) to McIntyre, 1 September, 1845, MS 61-62, Box 2, Folder 8; McIntyre to Porteous, 5 February, 1846, MS 74-18, Box 1, Folder 4; Archibald McIntyre to James McIntyre, various letters to James in 1846, then working at Auburn, with replies, MS 65-28, Box 19, Folders 19a and 19b.

24. Laws of the State of New York, 1847, Chapter 68, passed 15 April, 1847.

Notes

25. McIntyre Journal, September 20-22, 1843, MS 65-28, Box 6.

26. J. T. Headley, The Adirondack; or Life in the Woods, (New York, 1849), p. 53. See photos 1, 3-5 for views of the village.

27. McIntyre to Porteous, 21 September; 1 October; 11 October, 1847, MS 74-18, Box 1, Folder 5; 10 November, 1847, Folder 3; Porteous to McIntyre, 22 November, 1847, Folder 1. Photos 6 and 7 show this building - the only surviving 1840s structure intact.

28. Henderson (2nd) to Porteous, 13 January, 1846, MS 74-18, Box 1, Folder 8; McIntyre to Porteous, 18 March; 8 June; 3 October, 1846, Box 4.

29. McIntyre to Porteous, 7 December, 1846, MS 74-18, Box 1, Folder 8.

30. McIntyre to Porteous, 25 January; 12 February; 22 February; 25 February; 1 March; 8 March; 27 March; 1 June; 14 June; 2 September, MS 74-18, Box 1, Folder 5.

31. McIntyre to Porteous, 12 May, 1847, MS 74-18, Box 1, Folder 5; McIntyre to Henderson (2nd), draft of 21 January, 1848; Henderson (2nd) to McIntyre, 22 January, 1848, MS 61-62, Box 1, Folder 5.

32. Robert Clarke to Alexander Palph, 26 August, 1847, MS 61-62, Box 3, Folder 15; McIntyre to Porteous, 7 January, 22 February, 14 July, 1847, MS 74-18, Box 1, Folder 5. Interestingly, a W. M. Pickslay of Philadelphia, Pa., took out patent #59,644 on 13 November, 1866 for the "Manufacture of bars and articles of iron and steel combined." This may be the same Pickslay, who first appeared in a Philadelphia City Directory in . Subject Matter Index of Patents, Vol. 2: 783.

33. Allen Johnson and Dumas Malone, eds., Dictionary of American Biography, (N.Y., 1930), volume 5, pp. 329-39; James G. Wilson and John Fiske, eds., Appelton's Cyclopedia of American Biography, (N.Y. 1888), Volume II, pp. 186-7; Joseph P. Templeton, "Jersey City; Early American Steel Center," New Jersey Historical Society Proceedings, 76(July, 1961); 169:77; J. Owen Grundy, The History of Jersey City, (Jersey City, 1976), p. 30; Elbert Hubbard, Joseph Dixon, One of the World Makers, (East Aurora, N.Y., 1912).

34. Henderson (2nd) to McIntyre, 22 January, 24 January, 1848, MS 61-62, Box 1, Folder 5.

# CHAPTER VII

When the Adirondack Iron and Steel Company began the erection of a steel works in 1848, the company was merely carrying out in a large way ambitions the partners held since their first bloom came out of the forge in 1832. Crucible steel or cast steel had developed in England under the guidance of Joseph Huntsman about 1760, and England long monopolized this process that yielded a homogenous product suited for specialty uses such as springs and tools. The process involved three steps. First, wrought iron bars were packed into a closed chest in layers, completely surrounded by charcoal. After heating for 7 to 12 days, the heat and charcoal produced blister steel, named for the uneven surface of the bars after undergoing this conversion process. The blisters, or cementation steel varied greatly in quality, depending on the thickness of the bar. This process produced Damascus steel. Huntsman broke up the blister steel and melted it in closed clay crucibles that prevented contamination of the steel by the fuel. The result was a uniform product, which could be poured into ingots. The final step of the process involved hammering the ingots into bars. Huntsmen steel was a very high-quality product, considered almost as a precious metal. A great many American iron works tried, without much luck, to produce a comparable product. The first real success came in the early 1830s, with the works of the Garrand Brothers of Cincinnati. But competition with the British product soon forced that works to close. Pittsburgh, by and large, served as the seat of most of the American attempts to produce cast crucible steel.[1]

The challenge of successfully manufacturing cast steel appealed to McIntyre, and especially to Henderson. Not only did this product offer a financial reward, but producing steel also matched their opinion of how good their ores and iron were. Prestige and challenge were factors at least equal in importance to the economic incentives. For Henderson and Dixon, they were the main incentives. These concerns, for more than the desire to get wealthy, explained the whole expansion of the works from 1844 on. Without doubt, the partners anticipated gaining a good return on their investment. But Henderson and McIntyre at least, were already quite well off. In the moments of discouragement, they did stop and examine the prospect of ever regaining their investment. But even in their discussions about selling the property, their price did not include a large profit. Most importantly, the owners continued their efforts at the works, despite several chances when economic reasons might have dictated ending their involvement at Adirondac. The whole Adirondack Iron and Steel Company venture can only be explained if we recognize that the partners viewed the enterprise at their mountain to climb, because it was there. The steel works existed as an outgrowth of this motivation, and moreover served to justify the claims of the company regarding quality of their iron. But once again the partners were only partially correct about the quality of their product.

Dixon occupied the spotlight in this whole operation. Without him, the company could never have made any steel. By January, 1848, the crucible maker had already succeeded in making cast steel. A Mr. Ward, a local machinist, certified its quality. Henderson commented

> I think a great deal of Mr. W.'s certificate. He is such a prudent, cautious fellow, and must be very sure advised of anything before he would subscribe his name to it. He is also very competent from long experience to judge of this matter.

Of the principles from the company, Henderson's nephew appeared to play the largest role, since he resided in Jersey City. James R. Thompson, a cousin of Henderson's, and son of one of the members of the exploring party that discovered the ore bed in 1826, also played an important role in the development of the steel works. Thompson had served as the original clerk for Porteous from at least 1844 on, before getting involved with the steel works. Working with Dixon, Thompson learned the art of steel-making, and eventually replaced Dixon in 1850.[2]

The company made the usual start, as with any large project they embarked upon, of ascertaining how other firms were doing what the Adirondack Company wanted to do. Pickslay at the time of his 1846-47 venture, had developed extensive plans for the works, but had kept them for alterations, so the partners had nothing solid with which to begin construction. Henderson's nephew began to remedy this lack of knowledge by visiting the Hawkins and Atwater firm in Derby, Connecticut. Hawkins and Atwater had two good cementing furnaces for producing blister steel, with trip hammers and rolls. In fact, Hawkins, who Henderson saw there, wanted to form a company with Adirondack, using their iron to make cast steel. But while this merger did not occur, Hawkins did help the partners as they went about setting up shop, proving himself as helpful and open as Henderson had heard he was. Most important, Hawkins directed them to a converter, a Scotsman named Darby with 30 years of experience in cast steel plants. Darby could build tilt hammers, had a plan for the furnaces, would teach a man to convert iron for $100, and cement iron by the ton. A real find, Henderson hired the Scotsman for $2.50 a day for six months.[3]

By the end of March, affairs had progressed quite rapidly. The partners had purchased a building 145 x 75 feet on a lot at the Morris Canal basin at the waterfront. The building required little alteration and almost enough brick for the furnaces went with the sale. The property cost $11,650, with a $10,000 mortgage. They had also begun to investigate the necessary machinery. Robertson checked in Philadelphia, while Henderson looked for a steam hammer and engine in Jersey City. A Naismith-patent model attracted Henderson. To power that machine, a 25-horsepower boiler would suffice and would also run a six-horsepower engine. The engine would cost $3,500. The plans called for 16 melting holes to be put in, and three or four tilt hammers, at an expense of $400 to $600 each. To handle the actual construction of the furnace, there were a mason, four laborers, a blacksmith, and Darby. By the 31st of March, they had started the process of tearing out the old cones and furnaces already in the building. Finally, Henderson had retained Dixon as superintendent for a year at $1,200, plus 10% of any net profits, which they envisioned might run up to $70 to $100 per ton. The company was to supply him with iron at $125 per ton.[4]

The construction of the plant proceeded smoothly, and close to schedule. Machinery and construction costs apparently fell within the $12,000 estimate. Four carpenters and three more laborers joined the crew by the beginning of April. The boilers and engine had also been ordered from Providence. The only problem that marred the scene of progress was a dispute with Dixon. When Henderson had reached the agreement to hire Dixon, the partners had assumed that it superceded the earlier deal they had signed with him. Initially, the crucible specialist had agreed to make steel ingots, trying both charcoal and anthracite as fuel, to supervise the erection of the plant, and to teach someone how to make cast steel, for $1,000. But when the newer agreement began in April, he had only made six or seven ingots, and thus received just $500. Dixon became very miffed at being cheated out of the other $500. This argument nearly wrecked the plans to make steel because for a time, Dixon refused to provide any further help in the construction of the works. Dixon also threatened to leave and go to work for another firm, but the contract prevented that from happening.[5]

This threat and what McIntyre saw as Dixon's intransigence absolutely enraged the old Scotsman. He wanted Dixon fired as soon as possible, and even considered sueing him for breach of contract. His letter to Henderson on April 15th conveyed McIntyre's anger.

> I have neither time nor inclination to enter into any debate as to our agreement and understanding with Mr. Dixon; but if you state and understand truly what he now says and demands, I am decidely for breaking off all connections with him at once, or as soon as that can be effected. He must be a man (judging from his present conduct) destitute of any fixed moral principle of honor. I should judge, that he must either have been bribed by men who want to annex(?) our steel-making business; or by visionary men who contemplate making steel from Swedes or American ore. In either case, he and they will be disappointed. We shall go on despite of every oppostion. We have the iron equal or superior to any other on earth for providing superior cast steel and cannot fail of ultimate success. We have been retarded in our progress, first by Pickslay, and now most unfortunately & irrespectfully by Dixon's extraordinary and unjust conduct . . . If Dixon has had the offer you speak of, he will, of course connect himself with those who made them, disregarding all his honourable engagements with us. But let him go . . . we shall, it is true, be injured, but we will overcome the injury in time with other workmen . . .
>
> Dixon cannot surely succeed in his conclusion of the two contracts. If he demands the $500 under the old contract, let him forfeit it and then receive the money, but otherwise not a cent.[6]

The rift with Dixon never really healed after the bitter words used by both sides. But about May 10th, Henderson and Dixon signed a new agreement with a $500 bonus for his furnace, thus eliminating Dixon's main complaint. McIntyre remained leery, saying,

> It would appear that the deranged, immoral genius is coming to his senses. The agreement now proposed is not objectionable, if he will, after entering into it, do his duty. But what dependence can be placed in such a creature?[7]

Still, McIntyre recognized the value of Dixon's knowledge to the firm, and felt he would be satisfied if Dixon superintended the erection of the plant.[8]

The work had proceeded through all of this bickering, but not at the earlier pace. Delays in the delivery of machinery and problems in the erection of the pieces once they had arrived greatly delayed the production of steel in the plant. The cementing furnace did not present any great obstacles, and Robertson sent in two cargoes of coal from Philadelphia to fire it. The docks and building were ready by June 1st. By early July, the first batch of blister steel was produced. But a brick fell out of the furnace, admitting air and stopped production. The other branches of the works - the melting furnace and the hammers, lagged behind the converting furnace. Not until early October were the hammers ready for testing, and then problems with the condensor on the engine caused a further delay. Even in early November, the big hammer had not operated at all, and all of the others required further alterations. Then one hammer broke its helve after the earlier repairs had finally been made. As late as March 1, 1849, James Thompson still had to write to McIntyre,

> I suppose Mr. Strong keeps you duly informed of our progress at the Steel Works, and am very sorry he is obligated so long to report slow progress, but we sincerely hope soon to be able to report more favourably.[9]

No wonder Henderson had written that "Dixon is getting very impatient and anxious."

As far as steel making went, Dixon's steel making arrangements differed little from Huntsmen's plan, or from the schemes of other American producers. But his crucibles and one other change accounted for his success. Henry Dornburgh, in his reminescences of life at Adirondac, remembered that Dixon was initially successful with every step ". . . except pouring the steel in flat moulds, for when he put the iron under the hammer he found flaws and long seams in his cast steel. This he thought he could obviate by pouring the steel in the moulds endwise which would cause the air to ascend in the moulds as fast as they filled. This process was a revelation to the American people."[11] The result was a satisfactory cast steel.

One problem the steel works did not have to deal with was a shortage of skilled workers. Material needs, specifically high quality iron, played a vital role in the successful production of cast steel, but trained personnel were equally important. Apart from Darby, Henderson and Dixon experienced no difficulties in finding skilled workers, all Englishmen. In July, a father and son applied for work, the father as a melter. They came from Pittsburgh, and found Dixon's arrangements far superior. In November, Henderson hired two English hammerers, both good workers. Robertson had even received a letter from a tilter, the men who poured the crucibles, who worked for Pickslay in Sheffield. He had heard about the works in Jersey City from Pickslay, and wanted a job. It appeared that McIntyre, who had worried about finding workers for the highly skilled work at the steel works, had been needlessly concerned.[12]

Another worry of the McIntyre's was quality. By 1848, McIntyre had adopted this as his battlecry,

> I entreat that the Cementing be well done; for on that will depend the obtaining of good cast steel. It must be a point to be strictly adhered to, that not a pound of our steel be ever sold unless it is good. As we are sure we have the best material for C. steel we must try and try again until we produce the best . . . The steel will be the only thing to afford us relief from our heavy outlays.[13]

According to initial reports, the only surviving original owner apparently had little to worry about on this score. Almost from the start, the blister steel turned out well, and once the hammers began operating, the ingots also proved to be good steel, with very few needing remelting. Confirmation as to quality arrived almost as soon as the bars went into the market place. For that matter, the market was waiting for the steel. Mr. Cooper, "the largest iron master in New Jersey" wanted to buy steel for drills when available. Peter Townsend, a very influential ante-bellum iron master and owner of the Stirling Works, and a large number of other machine shops and steel users received samples of the steel for testing. Apparently plans to have Chilton, "the most celebrated New York chemist", or Hodges, mining and metallurgy editor of the American Railroad Journal formally test the steel, did not meet with Dixon's approval. Nonetheless, the practical tests won wide acclaim for the steel.[14]

An 1854 prospectus reprinted a number of letters from 1849 and 1850 which naturally enough testified to the virtues of the steel. Two of the more interesting came from military institutions, the Navy Yard in Washington and Springfield Armoury. In Washington, the engineer and machinist and the master blacksmith found that for all purposes, the Adirondack steel equaled the British article. The Master Armourer, Master Machinist, Forging and Machine Shop Foreman at Springfield made similar reports that must have seemed like vindication to McIntyre.[15] Other testimonials came from a wide variety of machine shops in the New York area, and these three letters offered typical descriptions.

> A cutter made of it was used in one of our largest lathes in very heavy wrought iron turning, and was found to be, (to use the phrase of the very competent and experienced lathe man) "prime," "tip-top"
>
> *        *        *
>
> The sample of steel...has been fully tested in a turning tool and chisel and has proved equal to any English Steel I ever used and have no doubt if the manufacture of all the steel is as good as the sample, the Adirondack Company will drive the English from the market.
>
> *        *        *
>
> If the steel manufactured by the American Adirondack Steel Company is equal to the sample you sent me, I shall hereafter give it the preference to any European steel we have had in this establishment for years. We have now a good assortment of steel on hand, but when we want to make another purchase, we shall send you the order.[16]

There were, however, difficulties with some batches of the steel produced in Jersey City, which indicated that McIntyre's fears about quality did indeed have a basis. The Winslow Iron Works reported that while some bars were good, others they called indifferent. Later the Jessups, a New York iron house, gave the steel only qualified approval. Archibald Robertson rationalized their difficulties in this way:

> ...it is more probable that like our Cutters and Blacksmiths here, they being accustomed only to work with the weak and impure steel manufactured there, do not know how to do justice to ours. If they should be sincere in their avowed purpose, of giving it a fair trial they will find out its merits.[17]

But James Swank probably captured the true situation in his assessment of the company.

> It is proper to add that, while good cast steel was made after 1849 at the works of the Adirondack Iron and Steel Company, the product was not for many years of uniform excellence. Much of it was good tool steel, but much of it was also irregular in temper. The exact truth appears to be that the cast steel produced by this company during the early years of trial, or from 1849 to 1853, was more uniformly excellent than that which had been produced by earlier or contemporary American steel works, the Cincinnati steel works of Garrand Brothers alone excepted. This excellence was due to the superiority of the Adirondack iron. Since 1852 the Adirondack works have had many rivals in the production of crucible cast steel.[18]

Despite the quality control problems, the Adirondack Steel Manufacturing Company, as the company was incorporated in 1849, produced a product that was far superior to almost every steel previously made in the United States. The results were as Thompson reported to McIntyre: the orders were coming in faster than they could fill them, "with the present hammers." The word of the tests, combined with the publicity in journals like the Journal of the Franklin Institute, the American Railroad Journal, the North American and United States Gazette, all gave the steel a creditable boost. But the nagging difficulties of occassional bad batches remained a vexing problem that soon overshadowed the initial optimism.[19]

McIntyre had one other worry, with his fear that the furnace could not provide an adequate iron supply to the steel works. As shall be discussed in the next chapter, there was some reason for concern in this quarter. If a shortage of the Adirondack iron did develop McIntyre wanted to know what would happen. He suggested using Norwegian or Russian iron. In the meantime, he took steps through 1848 to cut off shipments of iron to all other buyers. As it turned out, the long delay in getting the hammers operational eliminated any threat of a shortage of iron. In March, 1848, Henderson had reported that he had only 16 tons of iron on hand. But by the end of the year, the shortage had eased. In the long run, the iron supply problem settled itself, for the steel works could not work up all the iron produced by the furnace, even the small one was plagued by difficulties.[20]

The status of the steel works toward the end of 1849 emerged quite clearly in an exchange of letters between McIntyre and James Thompson.[21] McIntyre wanted to know how much iron the works had on hand, how much steel had been made, and what Dixon's chances were of producing iron from the plate metal without first refining it into bars. Thompson gave the following answers. They had 320 tons of Adirondac bar iron, 290 tons of good blooms and 10 tons of blooms of doubtful quality. Thompson figures that this 610 tons of iron would last two years, for the works could make only one ton of steel each day. The only bottleneck remained the hammers, but a large hammer from West Point, due any day, would make the one ton figure an easily attainable output. As far as steel output, the totals, apparently from the opening in 1848, read like this: 140 tons made, 40 tons hammered. Thirty tons had gone out or been sold, ten tons were on hand for agents. Thompson had the following explanation about these figures.

> You also ask what quantity of Steel has already been made, sold & unsold. You will doubtless be surprised at the smallness of the quantity when you hear it.
> You must first take into consideration the numeorous difficulties which had to be overcome in the hammering department, and the numerous delays caused by imperfect machinery and breakages, and another very important fact - That when you first commensed, your orders were all very small, mostly for samples, and of so many different sizes, that it required far more time to draw them; than it would to have drawn the same weight of ordinary sized steel.
> All these causes may to some extent assist in explaining why we have turned out so small a quantity of finished

> steel...The melting (that from which you anticipated the most trouble) seems to go on without any difficulty. As soon as you get the large hammer at work, I think there is no doubt, but you can hammer the steel as fast as it is melted. We are now turning out far more steel per day than we ever have been, and the reasons are these. The hammers are at present working better than they ever did, and our orders are larger and of more uniform sizes.

The most crucial point in McIntyre's question concerned Dixon's attempt to make steel directly from the pig iron, or plate metal as McIntyre called it because of the shape of the castings. Only small scale tests had been run, but those experiments had produced good metal. Dixon must have been working on a cementation process he patented in 1850 that substituted pig iron for wrought iron, and replaced the layers of charcoal between the plates with layers of pulverized iron oxide. Heated to cherry red for ten days, the pig emerged as steel, ready for melting in the crucible. Thompson had no doubt that Dixon would succeed. A large scale test with three tons of plate metal would settle the matter.[22]

Thompson concluded his summary with the note that the works at that moment ran quite smoothly, and orders outpaced production, "which speaks very well for the character of the steel." Things did seem to move on smoothly, with Dixon turning over eight tons of steel to their agent between the 10th and 24th of November, and two more tons ready to go. There were delays, of course. The installation of the new hammer closed the works for a period in January, 1850. "It is very perfect, and an enormously large piece of work, the largest piece of casting of this kind, I presume ever made in the United States." Problems with the boiler occassioned another shut down in February, and a shortage of black lead for the crucibles brought melting to a standstill in June, 1850, in a delay that lasted at least seven weeks.[23]

The delays with machinery and the problems with consistency utlimately took their toll with the prospects of the steel works. Toward the end of 1850, James Thompson assumed the role of superintendent, as Dixon finally departed. The rift with McIntyre had never healed, and his parting caused no tears. Robertson wrote that he was encouraged by the propsects for 1851. But in explaining why he felt things looked better, a sense of the problems the place had encountered, came through.

> Since Dixon has left the business has been carried on much more steadily and systematically than before, and the improvements in the melting department, by which sound ingots are produced with certainty and regularity is of incalculable importance. Heretofore at least one half of the steel after it was drawn out had to be broken up and remelted; now I am told not more than 2 or 300 lbs. of all that has been made since the works were

> started had to be broken up. The steel now made is also of a more mild temper and will give better satisfaction to users, than the harder quality which had been previously made. I understand that they are finishing about 1600 lbs. per day. The rolls will not be made till February and it will probably be March before they will be in operation.[24]

Unfortunately, these small problems had eaten away at the initially optimistic reception of the steel. Robertson observed that not all the steel was sold as it was made, for the character of some of the earlier steel continued to hurt the reputation of the company. The use of rolls were only one attempt to change that reputation. The challenge that the firm confronted remained the near-uniform excellence of imported British steel. By 1853, the Adirondack Steel Manufacturing Company as run by McIntyre and Robertson had closed Swank attributed part of the closing - it cannot really be called a failure - to "...the prejudice existing against American cast steel."[25] This factor played its part in the partner's abandonment of the steel making plant, but cannot entirely account for and explain the fate of the steel works, as shall be discussed below.

The key point was that the steel works did not remain closed. A ten-year lease was concluded almost immediately with Horner & Company, and Thompson may have stayed on as superintendent for awhile. But Swank observed Horner himself also met with varying degrees of success. At the end of the lease, Dudley S. Gregory, one of the initial proprietors of the Adirondack Steel Manufacturing Company purchased the property. With a new manager, named H. J. Hooper, the works settled down to produce good steel into the late 1870s. Enlarged between 1863 and 1866, the building thereafter housed five heating furnaces, 40 melting holes, five hammers, and four trains of rolls - 9, 12, 16 and 18 inches. With a 2400-ton annual capacity, the average make by 1876 stood at 1750 tons. By 1880, Gregory & Company had added two additional heating furnaces and two more hammers, raising their output to 3,000 tons. They continued using Northern New York and Swedish charcoal iron, and also re-rolled Siemens-Martin open hearth billets. About 100 men worked at the plant in the 1880s, after Andrew Williams bought it, and Hooper leased the works. But in 1885, the building and works succumbed to age and were dismantled by the Spaudling Jennings & Company. "At the time of their abandonment, they were the oldest active cast-steel works in the United States, having been continually employed in the production of this kind of steel since 1849."[26] The works had actually been going since 1848.

To the Adirondack Steel Manufacturing Company went a large measure of credit for pioneering steel production in the United States. The firm could claim, as the partners did, to have been the first successful cast steel manufacturer. But this meant very little, as other firms at the same time also produced steel. The Adirondack Company, of all the pioneers, probably produced the best quality steel. But there were the uniformity problems. Moreover, in business terms, the Adirondack Company could claim success only by bending the meaning of the word. The owners gained little, if any, profit from their venture. Still, the works made an important contribution to the steel industry, primarily through Dixon's graphite crucibles. These worked better than any others for the delicate work of melting the blister steel while protecting the metal from contamination by the coal.

An even more interesting way of defining the success of the Adirondack Company was the legacy of the people involved. Gregory, an initial stockholder, finally found the success formula for producing a uniform product. James R. Thompson went on to become one of the success stories of the crucible steel industry. He established his plant, the Jersey City Steel Works, of the J. R. Thompson Company, in 1862. By 1874, the works, very near the Adirondack works on Warren Street, consisted of one single and two double puddling furnaces, seven heating furnaces, four trains of rolls, five steam hammers, two helve hammers and 56 melting holes. Eight years later, another puddling furnace, 15 heating furnaces, a large train of rolls, and seven steam hammers had been added to increase output from 4,000 to 10,000 tons. By 1886, eighty 4-pot melting furnaces enabled Thompson to produce 14,000 tons of steel annually. Ultimately, the Jersey City Steel Works became part of the American Cast Crucible Steel Company, a trust formed at the end of the century.[27] Both through Gregory and Thompson the real legacy of the Adirondack Steel Manufacturing Company lived on. Their's were among the three or four firms that in the years right after 1860, "...dissipated the long-standing belief that this country possessed neither the iron nor the skill required to make good cast steel."[28]

Notes

1. James M. Swank, History of the Manufacture of Iron in all Ages, (Philadelphia, 1884), pp. 290-302. For information on the manufacture of crucible steel, see Overman, (1850), pp. 476-8; McGannon, ed., The Making, Shaping and Treating of Steel, pp. 20-23; K. C. Barraclough, Sheffield Steel, (Burton, Derby, 1976), pp. 12-13.

2. Henderson (2nd) to McIntyre, 14 February, 1848, MS 61-62, Box 1, Folder 5; Masten (1968), p. 111.

3. McIntyre to Henderson, (draft on Henderson's of 8 March), 11 March, 1848; Henderson to McIntyre, 24 January, 14 February, 8 March, 17 March, 1848, MS 61-62, Box 1, Folder 5.

4. Henderson to McIntyre, 31 March, 8 March, 10 March, 1848, MS 61-62, Box 1, Folder 5.

5. Ibid., 7 April, 14 April, 15 April, 1848.

6. McIntyre to Henderson, (draft on Henderson's of 15 April), 18 April, 1848; Henderson to McIntyre, 20 April, 21 April, 1848; MS 61-62, Box 1, Folder 5.

7. Henderson to McIntyre, 9 May, 12 May, 1848; McIntyre to Henderson, (draft), 2 May, 1848, MS 61-62, Box 1, Folder 5.

8. McIntyre to Henderson, (draft on Henderson's of 9 May), 10 May, 1848, MS 61-62, Box 1, Folder 5.

9. Henderson to McIntyre, 1 May, 25 May, 14 July, 21 July, 11 August, 12 September, 23 September, 25 September, 3 October, 9 October, 3 November, 8 November, 16 November, 18 November, 21 November, 23 November, 1 December, 3 December, 13 December, MS 61-62, Box 1, Folder 5; James R. Thompson to McIntyre, 1 March, 1849, MS 65-28, Box 4, Folder 10.

10. Henderson to McIntyre, 12 September, 1848, MS 61-62, Box 1, Folder 5.

11. Dornburgh, (1885), p. 8.

12. Ibid., 14 July, 21 July, 8 November, 31 March, 1848; McIntyre to Henderson, 27 April, 1848.

13. McIntyre to Henderson, (draft on Henderson's of 14 July) 15 July, 1848, MS 61-62, Box 1, Folder 5.

14. Henderson (2nd) to McIntyre, 16 August, 9 November, 18 November, 1848; McIntyre to Henderson, 14 November, 1848; MS 61-62, Box 1, Folder 5; J. R. Thompson to McIntyre, 7 March, 1849, MS 65-28, Box 4, Folder 10.

15. The Adirondack Iron and Steel Company, (N.Y., 1854), pp. 33-36.

16. Stillman, Allen & Co., Novelty Iron Works, to D. S. Gregory, President, Adirondack Steel Manufacturing Co., 2 May, 1849; E. Norris, Schenectady, to A. Hyer Brown, Agent, Adirondack Steel Co., 24 May, 1849; H. Thalhimer, Watervliet Arsenal, to Mr. H. Brown, 12 June, 1849; Black Notebook, Volume II, p. 211, McIntyre Correspondence, THS.

17. James R. Thompson to McIntyre, 19 April, 1849; McIntyre to Thompson, 8 June, 1849; MS 65-28, Box 4, Folder 10; Robertson to McIntyre, 13 June, 1850, MS 65-28, Box 5, Folder 22.

18. Swank, (1884), p. 299.

19. J. R. Thompson to McIntyre, 2 August, 1849, MS 65-28, Box 4, Folder 10. Journal of the Franklin Institute, , No. 1, (June, 1849): 405; American Railroao Journal, 22 (May 19, 1849:307; Clipping from North American and United States Gazette in J. R. Thompson to McIntyre, 12 May, 1849, MS 65-28, Box 4, Folder 10.

20. McIntyre to Henderson, (draft on Henderson's of 21 July), 22 July; Henderson to McIntyre, 11 August, 20 March, 1848, MS 61-62, Box 1, Folder 5; McIntyre to Robertson, Draft, 27 March, 1849, MS 65-28, Box 4, Folder 10.

21. Following information from McIntyre to Thompson, Draft, 25 September, 1849; Thompson to McIntyre, 27 September, 1849; MS 65-28, Box 4, Folder 10.

22. Ibid.; Patent #7260, Process for Making Cast Steel, 9 April, 1850. The test did not take place until the end of June, 1850. Robertson to McIntyre, 8 June, 26 June, 1850, MS 65-28, Box 5, Folder 22

23. Thompson to McIntyre, 27 September, 1849; 24 November, 1849; 7 January, 1850; 12 February, 1850; MS 65-28, Box 4, Folder 10; McIntyre to Robertson, 20 June, 1850; Robertson to McIntyre, 26 June, 1850, Box 5, Folder 22.

24. Robertson to McIntyre, 25 February, 1850, MS 65-28, Box 5, Folder 22.

25. Ibid.; Swank (1884), p. 298.

26. Robertson to James McIntyre, 17 Ocotber, 1857, MS 65-28, Box 5, Folder 13, John A. Ryerson, Directory of Jersey City, Horsimus, Hoboken, and Bergen for 1850-51, (Jersey City, 1850), p. 118; William H. Shaw, History of Essex and Hundson Counties, New Jersey, Volume II, (Philadelphia, 1884), p. 1159; American Iron and Steel Association, Ironworks of the United States, Philadelphia:1876, 122; 1880, 95; 1882, p. 96; 1884, p. 93; 1886, p. 153; Swank, (1884), pp. 298-9.

27. Swank, (1884), p. 300; Iron Works of the United States, 1874, p. 97; 1882, p. 97; 1886, p. 85.

28. Swank, (1884), p. 301.

# CHAPTER VIII

While the steel works occupied much of the time and attention of the owners from 1848 through 1850, the northern works continued to run. There were few changes in terms of structures between 1846 and 1850, apart from the Lower Works expansion.

The failure to locate the steel works at the Lower Works left that site with only an extremely expensive sawmill, considering the size and expense of the dam, which had cost $19,000. Richard Henry Dana, author of Two Years Before the Mast, visited the works in 1849, and his descriptions offered a good image of the village. He came through Indian Pass, as the explorers had in 1826. Within a mile of the pass and about 4½ miles from the works, he began to notice clearings, with piles of woods. "Gradually the clearings became larger, with acres of burnt and half-rotted stumps." The voracious appetites of the forge and furnace had resulted in the stripping of literally thousands of acres for charcoal wood. With the whole area now grown over again, it is hard to visualize the treeless vista Dana encountered.

Another visitor that same year was artist Thomas Cole, who sketched the village, and captured some of the barrenness of the area on paper. Cole's work echoed the words of Dana, who described the town of Adirondac in this way.

> It is the wildest spot for a village that can well be conceived of. In the very heart of the mountains, between two lakes, with a difficult communication to the southward, and none whatever to the northward, a small clearing is made, and amid the stumps of trees, the forest close upon them stand the iron works and the few attendant houses.
>
> * * *
>
> Here was no attempt at taste, hardly any at neatness or even comfort. Mr. Portens [sic], the agent, lives in the half of a house which in Cambridge could only be let to the lowest class of Irish laborers, and I saw that one room was kitchen, parlor and nursery. The only house at which strangers could be received was the boarding house, owned by the company, and kept by a very good fellow named John Might. In this house boarded lodged 96 laborers, all engaged in the furnace.[1]

Despite the rude surroundings, the furnace and puddling works continued to produce iron. By early, 1848, Henderson reported that the puddlers had started to improve their yield and to produce a more uniform iron. They worked on piece rate, at $10 per ton. Porteous also had two bloomers at work, apparently working the puddled iron into blooms at $9.50 and $11.00 per ton. The need for repairs forced Porteous to blow out the furnace early in January, 1848, but he had it started again within the month, having altered the boshes slightly. After the 1846 alteration, the furnace seems to have run fairly steadily, although the tuyeres must have needed replacement frequently. Henderson shipped several up in November 1846, and two bills showed that between September, 1847 and March 20, 1848, Porteous purchased 6 tuyeres and 4 nozzles pipes from the Crown Point Iron Company.[2]

The output of the stack still remained low, however, especially when compared to some other furnaces nearer Lake Champlain. Porteous seemed completely unable to produce more than 2 or 2½ tons of iron out the furnace each day. And this output consumed 200 bushels from charcoal per ton. This level of fuel usage would have been exactly at the average used by most cold-blast charcoal furnaces in 1830. But the hot blast at the furnace should have enabled Porteous to lower charcoal consumption below 200 bushels. Clearly, the 1844 blast furnace, in terms of fuel, was not an economical furnace.[3]

Porteous had continued to struggle with this difficulty, and the others that cropped up, such as low water that stopped all the works in April, 1848. He centered his efforts on the point that Henderson had fixed on-flux. He tested a wide variety of materials in the furnace, including a suggestion by McIntyre that he try wood ashes with clay. Supposedly, the potash would melt and unite with the clay to keep the slag thin, so it could run. McIntyre also wanted the lean, small grained ore from Calamity Brook tried, to see if the feldspar it contained might help the slag. Henderson's nephew, following in his uncle's footsteps, asked Porteous to send him samples of the furnace cinder, the Tahawus fire clay, and a reddish material found in the hearth in January, for analysis.[4]

Ultimately, though, the partners again turned to outside "experts", in their usual approach to problem-solving. Porteous began the 1848 furnace campaign with a Mr. Henry, "a man with considerable experience in furnace matters," in charge of the operation. This may have been the same Henry from Port Henry who Henderson and McIntyre consulted in 1843 about constructing this furnace.[5]

Another expert tried his hand at increasing the output of the Adirondac furnace during 1848. James T. Hodge was one of the more active mining and metallurgical engineers in the United States during the pre-Civil War era. Hodge spent most of the summer of 1848 in an effort to bring the furnace at Adirondac up to par, in one of the most determined attempts by anyone with scientific or practical training in the manufacture of iron. As a student at Harvard, Hodge had cultivated an interest in geology and mineralogy. After graduating in 1836, he worked on the geological surveys in Maine, New Hampshire, and Ohio. Eventually, Hodge parlayed his interests and knowledge into a position as one of the country's resident scientific experts on geologic and, especially iron, matters. Like Walter Johnson, James Booth, and the other chemists whom the Adirondack company consulted over the years, Hodge had performed property surveys for numerous firms, or states.

Among the companies that employed Hodge were the Montreal River Mining Company, the Union Pacific Railroad, and the state of Maryland.[6]

Hodge appeared in the national spotlight, for those interested in such matters, in the 1840s as assistant editor of the <u>American Railroad Journal</u> for mining and metallurgy. His first contact with the Adirondack Iron and Steel Company may have come in 1848, when Henderson's nephew discussed the possibility of incorporating the iron works with him. At that time, Hodge advised that the depressed state of the iron market made such an attempt inadvisable. But Hodge himself expressed an interest in the company. He had run the Tockbridge Furnace for 2 years, producing 12 tons a day from a furnace with a bosh diameter only 13 inches greater than the stack at Adirondac. Hodge felt that the Adirondack Iron and Steel Company's furnace should yield 6 tons daily, while using only 175 bushels of charcoal per ton. Quickly, Henderson enlisted Hodge. Providing him with samples of iron, ore, cinder and flux, the metallurgist began his analyses of the various components of the change.[7]

Encouraged by his findings, Hodge made the following offer to the owners. He would operate the furnace without pay. For every ton of iron above 25 each week, he would get a bonus. He planned to stay for 3 or 4 months, and had no doubt he could reach a weekly output of 40 tons, with 150 bushels of charcoal per ton. The only change Hodge anticipated making was the installation of another blowing cylinder. The company accepted this offer quite enthusiastically. Henderson figures it out this way. If Hodge made 45 tons a week for 6 months, his bonus would be $3000. He would save $1000 in charcoal and $400 in founder's wages. This savings amounted to $6 a ton, so for 1170 tons, the savings thus totalled $7020. This paid Hodge's bonus.[8]

So Hodge departed for Adirondac in late May, with high hopes. He had sent a sample of the ore to a Professor Hayes in Massachusetts for confirmation, of his own findings, for Hodge called Hayes "a man of standing as a chemist, geologist, etc." Haye's analysis matched Hodge's. Hayes, it turned out, was August Allen Hayes, a chemist who had studied under James F. Dana before serving as an assistant professor of that discipline at the New Hampshire Medical College. Settling in Boston in 1828, Hayes worked as the director of an extensive color and chemical factory, and served as a consulting chemist to "some of the most important dyeing, bleaching, gas, and iron and copper smelting establishments in New England." By 1850, it seemed that almost every major chemical or metallurgical celebrity on the East Coast had examined the Adirondac ores. Unfortunately, like all of the others, neither Hodge nor Hayes managed to do much to change the working of the Adirondac furnace.[9]

Hodge had a very rude awakening when he arrived at the village, and first talked to Porteous. That discussion indicated that his analyses did not tell him the whole story of operating a furnace on the Adirondac ores. His first try at improving the yield accomplished nothing, so Hodge headed back to his lab for further analyses.

> This will be handed you by Mr. Hodges, who has hurried home at once to make further analysis of our ores and fluxes, searching for detrimental impurities, as he is much surprised at the result of the working of our ores, after all the different experiments results made and obtained by Mr. Porteous, Mr. H. thinks he will not be able to accomplish anything like the yield in our present furnace he had anticipated, but for the moment is going to direct his attention to the obtaining of a good cinder and separation.[10]

While Hodge returned to New York, Porteous had to put a new hearth into the furnace. But Hodge came back in August, trying again to get the furnace to produce a liquid slag. He worked until the end of September, without effecting any improvement at all. He did try the Cheney ore for the first time, and found that this was the only ore of the group that produced a glassy cinder. But earlier tests had shown that the Cheney ore contained sulphur and would not work for steel, so the owners told Hodge not to use this ore. Finally, Hodge gave up.[11]

Hodge felt he knew why he had not improved the yield. A.A. Hayes had reported that his analysis indicated that the Mill Pond ore contained more than 10% titanic acid. The titanium, he said, made the ore refractory and, ". . . this is present in such proportion as to baffle all economical working of them with our present skill for the present purposes to which iron is usually applied." Hodge went on during the next winter to try 40 crucible tests with various ores and fluxes in an effort to solve the titanium difficulties. But like the other chemists, he was not even able to determine how much titanium was in the ore.[12]

Titanium has appeared before as a character in the story of the Adirondack Iron Works. Feuchtwanger noted its presence in 1834, Walter Johnson observed it, and Henderson tried to work with this chemical. Had Henderson lived, he might have made a connection between the titanium dioxide and the difficulties with the furnace. But when Hodge announced the find, McIntyre had no recollection of Henderson's or any of the others findings. He wrote, "It is not strange that by no analysis prior to this last by Mr. Hays (sic), we never heard of titanium? Your uncle received through Mr. Hope, I think, an analysis by some Scotch chemyst, which cost I think two guineas. I saw it, but have no particular recollection of it. I believe it said nothing about titanium . . ." Undoubtedly, the titanium had an impact upon the way the furnace ran, for the ilmenite did constitute 25% of the ore. The analysis that Hodge gave differed very little from the following description of the impact of titanium on a blast furnace.

> Titanium enters the furnace as titania, $TiO_2$, combined with some base, or as ilmenite ($Fe\ TiO_3$ or $Fe\ O \cdot TiO_2$). When titania comprises less than about two percent of the ore burden, 50 to 60 percent of the titania will be

> reduced and appear in the iron. When $TiO_2$ in the slag exceeds about 1.5 percent, slags may be very viscious and result in irregular furnace operation . . . Under the conditions prevailing in the furnace, titanium exhibits a slight tendency to combine with carbon and nitrogen to form titanium cyanonitride. This substance is sometimes found in the salamander of the hearths of furnaces being repairs. Here is occurs in the form of small cubes that have the appearance of copper.[13]

When Hodge's account of the furnace's operation is compared with the modern description, the parallels become apparent. The furnace worked with great difficulty, yielding a silvery, very hard iron, a mix between white or high iron and mottled iron. Hodge continued.

> What is singular, the hotter the furnace works, up to a certain point when it is sure to chill, the more it runs this peculiar silvery high iron, yielding it for weeks together. With various modifications in the form of the furnace, with hot and with cold blast, with every variety of flux that could be proccured, with ores <u>thoroughly</u> roasted, and in a raw state, and under the best skill and experience, <u>not a pound of glassy cinder</u> has ever been produced, nor the furnace been made to run freely for a day at a time. As it usually works, the cinder is of two kinds - one jet black and spongy, with shoots out like forge cinder and suddenly cools - the other a mixture of unreduced ore, iron, and charcoal, heavy and black, which is hauled out in great quantity from the hearth, where it collects without separation, threatening constantly to chill the furnace. There is another kind, obtained in experimenting with calcerous fluxes, of more stony structure, thick and heavy, which flows sluggishly and cools in wrinkles across current. This is a dangerous cinder, for it gets under the iron in the hearth, sticks close to its walls and is sure to fill it up, unless removed with the severest labor. Such fluxes are found by experience altogether unsuited to the ores. They are, worked with sand or quartz and a very siliceous clay, a part of which is made into a grout with the fine stamped ore - ten parts of ore to one of clay.
>
> *       *       *
>
> With a less able and enterprising company and a manager with any less than the extraordinary patience and perserverance of the present superintendent, Mr. Andrew Porteous, the works would long ago have been abandoned. But they continued from year to year under his care to turn out from one to two tons of iron a day. It is

> true this is with an unusual consumption of charcoal and of ore; but the iron is thought to possess such peculiar qualities for the manufacture of steel, that this expense is not so much regarded.[14]

The common points between the two accounts are the thick, heavy slag and the irregular operation of the furnace. As far as the titanium cyanonitride goes, that may have been the reddish material Henderson asked Porteous about finding in January, 1848. A geologist and a mining engineer at NL Industries, which now owns the village, explained how the titanium interferred with the manufacture of iron. The significant feature of the ore is that the magnetite, the iron ore, has 30 to 35 per cent intergrowths into the ilmenite, titanium dioxide ore (called titanic acid by Hodge and Hayes). As the NL writers explained it,

> ...around 1500°F, the ilmenite and magnetite intergrowth go into solid solution. It is at this temperature that the iron oxide should be reducing into iron; however in this solution of iron ore and titanium dioxide ($TiO_2$) the $TiO_2$ forms a glassy cover to the iron ore particles. This slows down or stops the reaction of ore to iron. In this glassy state, the $TiO_2$ is slow to react with the silica to form a slag. In fact, the reason why $TiO_2$ is used as a paint pigment is because of its unreactive nature ... Thus, the reason for the "hard reduction."

Significantly, the Cheney ore that Hodge did experience some success with did not contain the intergrowths, or mixture of ilmenite and magnetite, which explained his success. Moreover, the sulphur content of the Cheney ore bed was not higher than the other ore bodies as McIntyre believed, so Hodge might have worked them after all. But that missed chance must now go under the historical heading of "What if...?"[15]

The modern understanding of the metallurgical process, unfortunately, was not available to Henderson, or Porteous, or Hodge. Perhaps it was as well, for then they would never have tried to work the ores. Even today, the steel industry in the United States has continued to shun these ores. A metallurgist working at the turn of the century, Auguste J. Rossi, the developer of titanium dioxide paint pigments, showed that the titaniferous magnetites could be worked in blast furnaces, but they did require special care.[16] In light of these troubles, Porteous's continuous struggle stood out as a truly heroic effort. Hodge's praise was definitely earned.

Ironically, the presence of the titanium did help account for the exceptional quality of the iron the furnace did produce. Titanium is regularly used as an addition to iron castings, for it seems to decrease the size of graphite flakes that form when pig iron is slowly cooled. By reducing the tendency for these flakes to form, titanium increased the strength of the iron. "A little titanium, 0.05 to 0.10 percent, is common in pig iron, and its effect appears to be generally beneficial. The addition of titanium is reported to impart greater toughness and resistence to wear." Moreover, titanium can be added to steel products to produce alloys with great abrasion resistance.[17] As Rossi observed in 1892, "Whenever (as in Europe, Canada, or New York) such (titaniferous) ores have been smelted, the iron has been found excellent."[18] The titanium, then, was a double-edged sword to the iron produced at McIntyre, for while it greatly complicated the task of smelting the iron, the pig metal produced was of a greater hardness.

In the end, Porteous continued to run the furnace as experience had taught. The iron yield did leave something to be desired, for too much iron went out the taphole with the slag. Hodge's account of the furnace operations was important because it showed just how serious the problems were. That the owners persevered under these conditions was truly fantastic. Porteous continued to battle difficulties beyond the actual reduction of the ore. The water shortage that brought all operations to a halt in April, 1848, has been mentioned above. Then early in November, 1848, a fire completely destroyed the tophouse, a frame structure that covered the wooden trestle giving access to the top of the furnace. There the topmen fed the raw materials into the furnace, or (in technical parlence) charged the furnace. This accident forced the furnace to stop until a new structure was built. But in about three weeks. Porteous again had the stack producing iron.[19]

Largely through the exertions of their superintendent, the anticipated shortage of iron at the steel works never developed. As it worked out, the steel works never seemed to work up to its 200-ton annual capacity, and the figures do not exist, for the furnace books have not survived. The furnace seemed to produce a rather steady 15 to 18 tons each week. Henderson's nephew, when calculating Hodge's bonus, assumed 6 months of operation for the furnace annually. This may indicate the average period of time in blast. Some years, the furnace did seem to run longer. But if 6 months was Henderson's guess, that would yield an annual production of about 450 tons. That figure must be high, for no evidence indicates such an annual tonnage. But somehwat lower figures are confirmed by the statement that over the winter of 1847-8, the teamsters handled 270 tons of freight, in both directions. Incoming supplies probably tallied in the vicinity of 50 to 70 tons, perhaps less, leaving 200 for refined iron. And waste in the refining process had only reduced this weight by at least 1/3 from the total produced by the furnace. The figure of 150 tons given by Henderson for iron received in Jersey City by November 23, 1846, might be right because that year the furnace did not start until late June.[20]

The only existing figures come from very sketchy accounts of the amount of iron the various bloomers converted into bars and blooms. From these records, an indication of the production of the furnace can be had. Thus over a period covering 1847 and the spring of 1848, Wilson Calking produced 228,366 pounds of blooms, more than 101 tons, 18 cwt. For a shorter period of time in 1848 and 1849, Daniel Gates worked 492 blooms at 46,261 pounds, and 1557 bars at 69,043 pounds - almost 51 tons of iron. Calking and Gates do not seem to have overlapped in their employments.[21] Other correspondence implied that there were two bloomers working at a time, so these figures do not represent all the iron produced. But again, they indicate an annual production of bar iron in the 150-200 ton range.

The most complete set of production figures were for the shipments of bars and blooms from Adirondac to Tahawus, from June 17, 1848 to March 2, 1849. In that 8½-month span, the company clerk, Alexander Ralph, recorded the shipment of nearly 429 tons of iron.[22] This figure came the closest to indicating that the furnace could approach the hypothetical 450-ton figure mentioned earlier. The correspondence also indicated the furnace remained in blast nearly the entire year of 1848. No other year ever approached 1848 in terms of production for no other shipment figures came near this total. Rather, the output probably remained near the 200-ton level. An undated account of shipment of blooms out of Tahawus, possibly for the winter of 1849-50 totaled 4119 blooms at 441,256 pounds, or 220½ tons. In the winter of 1850-51, the clerk recorded 163¼ tons of pig iron leaving the works. In 1851-52, this total dropped to 89 1/7 tons, while 98 blooms weighing over 3½ tons went out in July, 1852.[23]

These figures corroborate the tale told through the letters, that none of the advice or experiments ever improved the yield of the furnace. Hodge's attention in 1848 may have kept the stack in blast longer than other years, raising the total produced. But the rate of production and yield did not change under his ministrations. Porteous, the amateur, by 1848 knew how to make the Adirondac ores run into iron better than anybody else, and did so steadily if unspectacularly. The cost, in ore and charcoal would have quickly ruined most other iron works, but located on the ore bed, and surrounded by unbroken forest, the works at least faced no threat of exhausting either resource. Only the goal of making steel gave any hope of the works making sense economically.

Porteous continued through 1848, 1849, and 1850 with the usual chores, the litany of needs he annually dealt with. Supplies came in each year, and at times he had to bring in pork or flour in the summer when the normal supply gave out. Porteous managed to procure 650 bushels of wheat up north in early 1848, but could never depend on a local supply. By 1849, the Newcomb farm had been abandoned, although hay and possibly some vegetables may still have been grown there.[24] As always, supplying Adirondac was a real headache.

Keeping the roads in some kind of passable condition was also difficult. The work was never-ending. McIntyre got so fed up with the demands for keeping the mud holes open that in 1849 he directed Porteous to spend nothing more on roads. But Hodge had noted that freights on iron to New York ranged from $12 to $18 a ton, so that a major effort had to have been mounted in late 1848 and 1849. Such efforts may have paid a temporary dividend, in lowering that rate to $9 a ton. But the outlay probably only equalled the savings. Visionary schemes continued to appear, like the plank road boosted by citizens of Schroon River intended to link them with the iron works in the west, and Warrensburg and Glens Falls in the south. Naturally, nothing came of this dream.[25]

The year 1848, however, did see Adirondac receive official recognition of its existence. Orlando Kellogg, the representative for the area, pushed a petition through the Post Office Department that secured a post office for the village. The certificate appointing Porteous post master was dated October 14, 1848. Mail initially came in once a week from Minerva, and later from Schroon River.[26]

No year at Adirondac went by without some kind of excitement, be it new buildings or major experiments. In 1848, the Hodge experiments had been the key attraction. In 1849, Porteous made his own excitement by trying his hand at making cast steel. Just what the motivation for these experiments was never became clear. Perhaps Porteous felt upstaged by the movement of the steel works from Tahawus to Jersey City, But his goal was evident - the works manager intended to prove that the company could convert the Adirondac bar to cast steel with charcoal, at Tahawus. By November, Robertson and Robert Clarke, a nephew of Robertson then working at the steel works in Jersey City, were anxious to hear the results of Porteous's attempts. But Porteous had a great deal to learn about steel making. Clarke pointed out one mistake. Porteous first decarburized the plate and then melted it, just as Dixon did. But he then decarburized the ingots again. Clarke correctly worried that this last step might reduce the steel to malleable iron - wrought iron. Still, Clarke had high hopes; "...we are expecting daily to receive the first shipment of bonafide Adirondac steel to take the place of the Jersey counterfeit."[27]

Porteous had taken over the puddling furnace for his experiments, but ran into two major difficulties. The first related to patent infringement on Dixon's work. Except for the fuel, the process used by Porteous was the one Dixon outlined in his 1850 patent. The only hope was that Porteous might find a way to melt the decarburized plate without crucibles. As Clarke noted, the crucibles cost $1 each, and it required 16 to melt a ton of steel. A decided savings would have resulted from success on this point. Other advantages to making steel at Adirondac would have been elimination of some property in New Jersey, and some transportation costs. But the big problem of melting without a crucible did not solve easily. And other problems emerged, like the lack of suitable hammers at the village to pile the ingots of steel. Also, steel melted in the furnace without ingots picked up some contaminating cinder. Robertson and the others remained hopeful through the end of 1850, but the plan was doomed to failure.[28] Despite the hopes of Porteous, Adirondac never boasted a steel works.

Porteous's dream really must be considered unrealistic, if only in terms of cost. The process on which the works superintendent pinned his hopes would have had to offer a very drastic savings before the owners would have abandoned the new works in Jersey City that had cost so much - probably $50,000 went into them the first year. The steel works and the establishment at Adirondac nearly proved too much for the partners anyway. Until 1847, money very rarely came up in the correspondence. But once the company began to construct the Lower Works, followed a year later by the steel works, expenditures became a major topic of conversation.

There was good reason for this concern. The money expended after 1847 made the expenditures that Henderson and McIntyre had worried about in 1843 seem very small. In fact, the two works at times seemed to hemorhage money. The account and ledger books of the Iron and Steel Works, like almost all of the other corporate records, no longer exist. But the correspondence again can given an order of magnitude for the outlays involved. In 1847 alone, just a portion of the expenses that McIntyre covered for Porteous in the way of drafts totaled over $21,000. The bank greatly complicated matters as well, for an unending stream of McIntyre Bank notes poured into the state treasurer's office in Albany, where they required redemption.

By the end of 1848, McIntyre had fallen into serious financial problems. He needed to redeem $1857 in McIntyre Bank notes, a draft for $1000 had arrived, several hundred dollars in taxes awaited payment, the pork bill of $145 remained unpaid, and $1600 on his own account came due very shortly. The partial list of expenditures still came to an impressive total. For 1848, the owners shelled out $60,433.47, with at least $24,347 going to redeem bank notes. The outlay listed in letters in 1849 totaled $59,838. Of this, $38,008 went to the steel works, and $20,080 found its way to the village.

The correspondence for 1850 indicated only $7734 in direct expenditures, through February 14th. This amount was split $4422 for Adirondac and $3312 for Jersey City. But McIntyre reported he faced the problem of redeeming $20,000 in McIntyre Bank notes in May. So the very partial accounting for 1847 through 1850 came to $170,000, a stupendous amount for the time. The unfortunate feature was that these expenditures actually produced little improvement in either the iron or steel making plant. The $38,000 sent to the steel works in 1849 was money for salaries and incidentals, not for plant or equipment additions. Neither facility had come near to breaking even. As McIntyre commented to James Thompson in 1849, "That Adirondac has become a wonderful sink for money."[29]

The equally important question then surfaces; where did the money come from? From the sounds of the letters, McIntyre paid most of the drafts. But he did keep annual accounts for a fair settlement. The Henderson estate was tapped for its shore, on occasion at least, and Robertson was equally involved. He sent McIntyre $20,000 in June, 1850, to redeem bank notes. By and large, the two enterprises lived off the other successes of the owners. Plainly, the amount realized from the sale of iron and steel did not cover all expenditures, although lack of information relative to total production and selling prices prevented any type of accurate calculation.

One sample can demonstrate the problems the owners faced. The steel works probably turned out 150 to 200 tons of cast steel a year - the first year, through October 1849 saw 140 tons of steel produced. In 1854, the following price schedule was said to apply to Adirondac iron and steel - $120 per ton for hammered bar iron, $180-200 for blistered steel in bars, $350 a ton for ingot steel.[30] Had the first year's steel sold at that price, the gross return would have been $49,000. But $38,000, at least, had been sent to the works, and that did not include the $17,500 that the owners charged Dixon for the bar iron - 140 tons at $125 per ton. Even without considering the initial capital expenses for building the works, the steel works clearly faced red ink on its balance sheet. And the same reasoning indicated a worse situation at the furnace. Adirondac pig brought $50 a ton in 1854, the bar iron $120. Thus, the 1848-49 revenue for the iron shipped from Tahawus would have been about $36,221, again not enough to cover the costs, much less a return on investment.

If the owners supplied the financial spring on which the works floated, that spring had its source in the early business ventures like the lotteries, Henderson's pottery, and Robertson's real estate ventures in Philadelphia. But such a money supply could never flow unreplenished forever. So the company had made efforts to supplement the resources available to them. One scheme had the firm selling 100 acres of land to employees for $3 an acre over 5 years. Payment was to be made in cordword for charcoal at 9 shillings ($ .45) a cord. These sales could have lowered the expense of making charcoal. But how many men actually purchased land in this way is not known.[31]

The other scheme called for Porteous to sell timber on portions of the 106,000 acres the company owned, in order to end the drain on the owner's wallets. McIntyre had actually hoped to sell enough timber to supply all of Porteous's financial needs. The sales began in 1845, on parcels of land remote from the iron works. One group of pine logs brought $2848.56 to Porteous in 1846. But the massive cutting necessary to sustain the iron works just was not possible, practical, or even considered. Still, timber sales, solely of pine logs, continued every year, resulting in some small measure of relief.[32]

Probably because of the way the financial burden seemed to increase at the time when the owners felt they had good reason to expect the two works to begin paying their own way, the period after 1849 was marked by a very different tone. The mood had been changing since Henderson's death, and by 1850, the shift was complete. The owners had determined to keep expenses as low as possible, and a certain peevishness appeared in their letters to the manager. McIntyre had always adopted a philosophical outlook toward the expenditures. In 1846, he had written Porteous, "I am well aware that your expenditures are heavy, and must continue to be so. Our business will be to keep you supplied as we can." As to their value, McIntyre penned, "If the expenditures are heavy, it is gratifying to know that they are not wasted, but used in a vigorous prosecution of work, that shall be very beneficial, which I cannot but hope and believe will be so."[33] But the generous, magnanimous tone had disappeared in this 1850 letter to the company clerk.

> I have seen the bill of groceries purchased by Mr. Clark, when down, and I really cannot help expressing surprise as to many of its items. Pray where was the need for 3 lbs Sugar in addition to what has been previously sent? Can Mr. Robertson's instructions as to work to be done next year have given you the idea of a necessity for such quantities of sugar? Again: there must be a wonderful change in the population of your county to warrant the laying in of 12 boxes Raisins, 6 mats(?) casia, 1 box citron, with other fancy articles.[34]

It was at about this time that Andrew Porteous departed from the Adirondack Iron and Steel Company, apparently in the midst of controversy and bitterness. No explanation for his dismissal emerged from the correspondence. His fall from grace must have been precipitous, though. In December, 1850 Porteous was being encouraged about his steel-making experiments. Robertson even sounded hopeful about moving the steel works to Adirondac. But by September, 1851, after he had been gone for at least a short while, Robertson called him. "... that scoundrel Porteous ..."[35] Perhaps Porteous ran afoul of the new economy-consciousness, and left in a huff because of the decision not to add the steel works to his responsibilities at Adirondac. More likely, he grew tired of the unremitting effort required to make the place go. Whatever the reason, his departure for Luzerne, not far from Saratoga, was symbolic of changes at Adirondac. Porteous had served as the spark plug of operations, and represented the same driving optimism and activity as Henderson. But when Porteous left, that drive disappeared, and the hope of success seemed fainter than ever. Porteous's departure must have further dimmed the chances of success. Certainly the events of the next few years at Adirondac presented a very different outlook than the goings-on that characterized the tenure of Andrew Porteous.

Alexander Ralph replaced Porteous, and ushered in the era Dornburgh called "The Nephews of the Company."[36] Ralph had been Porteous's clerk for a couple of years, but had no iron-making experience. This shortcoming was no real handicap, however, for the pessimistic outlook of the owners relegated iron production to a back seat position. Instead, the owners focused their primary efforts on selling the property. These renewed and repeated efforts to find a buyer indicated most sharply the partners' increasing discouragement with the prospects of their iron and steel works. The financial drain was not the sole motivation for this push. In 1850, McIntyre turned 73, and increasing age had forced him to slowly, but surely, withdraw from the decision-making processes of the company. Bad eyesight and poor health generally limited his abilities, for he claimed he was too unwell to follow anything that did not demand close attention. McIntyre went on, attesting to his great desire to be rid of the burden of the Iron Works. "...my great anxiety for a long time has been to rid myself entirely of that and some other properties, and I pray to Heaven I may be able to dispose of my interest at Adirondac at any price."[37] Robertson echoed these sentiments, for he, too, was anxious to sell. The Philadelphia broker had taken more of an interest in the company after 1845, but his greater geographic distance from Adirondac had focused his attention on the steel works. Robertson retained outside interests, but allowed his other properties to deflect his mind from Adirondac, unlike McIntyre. By the early 1850s, Robertson held the position of Treasurer for the New Orleans Canal & Navigation Company. This venture planned to improve the Mississippi River Channel between New Yorkleans and the Gulf of Mexico, but failed dismally, dragging Robertson into yet another financial quagmire. But in the meantime, he pushed for a sale of Adirondac.[38]

> We must make up our minds to bear with these disappointments and delays in getting persons to unite with us: I still think that we will succeed before long: But should we be disappointed we must just go on in a moderate way, according to our means, and depend upon the profits for meeting the outlay, which I think we may depend on with much certainty, considering the stock of iron etc. we have on hand, and probably a considerable surplus, unless we should conclude it best to invest it in further improvements and enlargements of the works.[39]

Robertson's last lines indicated that not all resolve had disappeared, however. The works were entering yet another crucial period in their existence. Like most family owned and operated firms, the transition from one generation to the next demanded hard work and good luck. But no willing heir from any of the three owners' families emerged, to step into their fathers' shoes. Moreover, with McIntyre's informity and Robertson's outside concerns, there was no clear leadership from the older generation, and certainly not the stronger management Henderson had tried to bring to the works, although Henderson had always remained an absentee owner himself. McIntyre recognized the problem, for as he said to Robertson, "I may have thought, and still think, that if the business were in the hands of owners who could attend to it, that it might be better managed..."[40]

Unfortunately, those who were interested and remained enthusiastic about the works had not the means to become actively involved in the sales plan of the direct owners. James R. Thompson and Alexander "Sandy" Ralph both wanted to have a crack at running the works on their own, but outright sales took precedence. "I am satisfied," wrote Thompson to Ralph, "that we could make a fine thing out of a short lease of Adirondac. And Uncle (Robertson) seems perfectly willing that we should have it if that suit is not effected, but I begin to fear we may be gray-headed before that matter is settled..."[41] But these young men could never have found the capital needed to buy the works, and as only nephews, they stood too far outside the family to come into the estates. So the company, looked again to outside "capitalists" for salvation.

The partners had never really stopped its efforts to attract the attention of outside money interests. But through the expansion of the mid-1840s, sale had not been mentioned at all. The difficulties increasingly apparent through 1849, however, led to new efforts in the direction of selling the property. In 1849, the owners seem to have retained a Mr. Archibald to actively push their interest. He engineered a deal to sell 3/4 of the firm to a Boston party, but it fell through. In 1850 Archiblad also approached the Bairds again, and escorted a Mr. Whitelaw through the works. Whitelaw was on an inspection tour of works in New Jersey, Pennsylvania, Quebec, and Montreal, and he planned to at least visit Adirondac. But nothing materialized from either effort, although Whitelaw did express an interest in the place. Still, as McIntyre related,

> ...from the short stay W. contemplated making at Adirondac I imagine he does not think it worth while to devote much attention or thought to the Steelmaking business. I had encouraged the hope that the Bairds might engage with us, but I now despair of their doing so.
>
> Another year is passing rapidly away without any prospect of a sale that I can perceive. This alarms and grieves me, when I consider our situation. Perhaps when we shall be incorporated, some sales of shares may be effected.[42]

The incorporation he mentioned took place later in 1850, when T. G. Younglove, a lawyer involved in the company's affairs, guided the requisite law through the New York legislature. The provision that mattered was the right of the company to give stock in return for the land owned by the individual owners, especially Henderson's estate. With the passage of the bill in April, a referee was appointed by the state to appraise the land, and by the end of June the owners were finally ready to organize and incorporate.

As incorporated, the Adirondack Iron & Steel Company had a capital value of $625,000, divided into 2500 shares of $250 each. The distribution of shares stood this way: McIntyre owned 903, Robertson and the Henderson estate received 781 shares each and J. McNaughton, James McIntyre and D. S. Gregory had 10 shares each. The sole reason for obtaining the special bill was to facilitate the sale of the property, as the petition to the legislature made clear.[43] But still a sale eluded them.

The efforts to find an English buyer led the firm to send an exhibit to the Crystal Palace in London during 1851. McIntyre laid out the plans to Ralph in a postscript in this letter.

> It is intended to send to be exhibited at the World's fair in London, specimens of our Adirondack ores, pig and bar iron, and cast steel. To have them go in our Government vefsel, they must be delivered at the Navy Yard in Brooklyn on or before the 10th January. Please therefore to bring or send 1 or 2 pigs, and a handsome specimen of, say a foot square from each of our three principal beds, vis: the black ore at the head of the mill pond, the fine grained on the hill, east of the works, and from the sanford orebed.[44]

The owners arranged for B.P. Johnson, agent for New York State, and Eliot Cresson of Philadelphia to watch after the interests of the firm, and "...to draw the capitalists attention so far as to induce them to come over and see it, and then buy it if they like it." The two overseers stood to gain a 12% commission for their efforts, but Cresson expected little luck, for the economy was edgy in England, with a panic expected. Still, the exhibition on its own merits had to be counted a triumph for the Adirondack Iron and Steel Company. The products overall won a prize medal from the committee, and the cast iron and steel received honorable mentions. Krupp was the only other foreign steel maker to be so honored. The New York Agricultural Society chose that occassion to present the company a gold medal and a silver medal, each reflecting the London awards.[45] Such recognition did not come to a firm every day.

To further enhance the chances of a sale by Johnson and Cresson, Robertson apparently arranged the publication of a pamphlet entitled "Advantages of the Works and Property of the Adirondac Iron and Steel Co..." Following the usual pattern, he attached a portion of Emmons's 1840 report to the short statement. After the detailed and glowing description of the iron and steel works, Robertson discussed the purpose of the little booklet.

> A portion of the stock in these two companies, say one-half, two-thirds, or three-quarters, is now offered for sale; not because of any want of success or prosperity attending the enterprise, for such is not the case, as can be shown to the satisfaction of any one, but from the fact that the present proprietors, owing to peculiar circumstances, are not in a condition to carry on the business to the best advantage, nor to enlarge the works. More than one-quarter of the stock is owned by minors, who guardians under their limited powers, cannot with facility and safety carry on the business for them; and another person, who owns three-eighths of the stock, is far advanced in life, and for that, and other reasons, is desirous of disposing of a portion of his interest.[46]

The terms were that the two plants counted as one company, for each had the same number of shares, with the 2500 shares valued at $300 each. The asking price was thus $750,000 or £150,000. If a portion only were purchased, the owner had the option to buy the remaining share within 2 years, total price then to be $1 million.[47] But the salesmen had no luck at all; not even a nibble was reported in the surviving correspondence. Despite the medal at the Crystal Palace, the Adirondack Iron and Steel Company remained in the hands of McIntyre, Robertson and the estate of David Henderson.

# Notes

1. "Adirondack Iron and Steel Company", (N.Y., 1854), p. 42; Richard Henry Dana, The Journal, (Cambridge, Mass., 1968), pp. 365-6; See Photograph 1 for Cole's sketch, and photograph 7 for the [illegible].

2. McIntyre to Porteous, 22 December, 1847, MS 74-18, Box 1, Folder 5; Henderson to McIntyre, 31 January, 1848; MS 61-62, Box 1, Folder 5; McIntyre to Porteous, 10 November, 1846, Folder 3; Receipts from Crown Point Iron Company, Payment received 15 April, 1847, 29 March, 1848; MS 74-18, Box 1, Folder 10.

3. Henderson to McIntyre, 10 March, 20April, 1848, MS 61-62, Box 1, Folder 5; Peter Temin, Iron and Steel in the Nineteenth Century, (Cambridge, Mass., 1963), p. 39.

4. McIntyre to Henderson, (draft on Henderson's of 7 April), 10 April, 1848, MS 61-62, Box 1, Folder 5; McIntyre to Porteous, 18 April, 30 March, 1848, MS 74-18, Box 1, Folder 5; Henderson (2nd) to Porteous, 3 April, 1848, Folder 8.

5. Henderson to McIntyre, 31 January, 1848, MS 61-62, Box 1, Folder 5.

6. The National Cyclopedia of American Biography, Volume 4, (New York, 1906), p. 548; The National Union Catalog, Volume 149, pp. 124-5.

7. Henderson to McIntyre, 8 March, 10 March, 31 March, 1848; MS 61-62, Box 1, Folder 5.

8. Ibid., 25 April, 20 April, 1848.

9. Ibid., 12 May, 1848; McIntyre to Henderson, (draft on Henderson's of 12 May), 13 May, 1848, MS 61-62, Box 1, Folder 5; Appleton's Cyclopedia of Biography, Volume III, p. 132.

10. Henderson to McIntyre, 5 June, 7 June, 1848, MS 61-62, Box 1, Folder 5.

11. Ibid., 5 June, 12 September, 19 September, 1848, McIntyre to Henderson, (draft on Henderson's of 16 August), 21 August, 13 September, 23 September, 1848; MS 61-62, Box 1, Folder 5.

12. James Hodge, "Iron Ores and Iron Manufacture of the United States: New York," American Railroad Journal, 22(October 13, 1849): 639-40.

13. McIntyre to Henderson, 23 September, 1848, MS 61-62, Box 1, Folder 5; Harold E. McGannon, ed., The Making, Shaping and Treating of Steel, (Pittsburgh, 1971), p. 456.

14. Hodge, (1849), p. 639.

15. Thomas Joyce and John Oxenford, "The McIntyre Blast Furnace," Tahawus Cloudsplitter, Vol. XXII (January-February, 1970), p. 12; Conversation with Walter Chapman, Mine Superintendent, NL Industries, Inc., Tahawus Development.

16. See Chapter XII; also, A.J. Rossi, "Titaniferous Ores in the Blast Furnace," American Institute of Mining Engineers Transactions, Vol. 21 (1892-93): 832-67; "The Smelting of Titaniferous Ores," The Iron Age, Vol. 57 (February 6 and 20, 1896): 354-6, 464-9.

17. The Making, Shaping and Treating of Steel, p. 1067, 1070; United States Steel, for example, produces two titanium alloy steels.

18. Rossi, (1892), p. 838.

19. McIntyre to Henderson, 14 November; (draft on Henderson's of 16 November), 17 November; Henderson to McIntyre, 16 November, 23 November, 1848, MS 61-62, Box 1, Folder 5. Thomas Cole's sketch, photograph 1 showed the furnace as it looked at this time.

20. Henderson to McIntyre, 18 November, 1848, 23 November, 1846, MS 61-62, Box 1, Folder 3.

21. Rough sheets of calculations, F Misc. File, McIntyre Correspondence, THS.

22. Ibid.; See Table 1.

23. Ibid.

24. McIntyre to Porteous, 30 March, 1848; 6 June, 1849, MS 74-18, Box 1, Folder 5; Henderson to McIntyre, 14 July, 12 September, 1848; McIntyre to Henderson, 23 September, 1848, MS 61-62, Box 1, Folder 5; McIntyre to Porteous, 22 February, 1848, MS 74-18, Box 1, Folder 5.

25. McIntyre to Henderson (Draft), 14 March, 1848; Henderson to McIntyre, 21 April, 1848; MS 61-62, Box 1, Folder 5; Hodge (1849), p. 639; McIntyre to Porteous, 22 February, 1848, MS 74-18, Box 1, Folder 5.

26. See MS 61-62, Box 3, Folder 14.

27. Robert Clarke to Alexander Ralph, 12 November, 1849, MS 61-62, Box 3, Folder 15.

28. Clarke to Ralph, 28 November, 1849, MS 61-62, Box 3, Folder 15; Robertson to Porteous, 23 January, 20 June, 1850, MS 65-28, Box 5, Folder 22; McIntyre to Porteous, 14 February, 1850, MS 74-18, Box 1, Folder 7; Robertson to McIntyre, 26 June, 25 December, 1850, MS 65-28, Box 5, Folder 22.

29. McIntyre to J.R. Thompson, (Draft of Thompson's of 4 April), 6 April, 1849, MS 65-28, Box 4, Folder 10. Information on expenditures was culled from a wide number of letters in the Adirondack Museum collection, in MS 61-62, MS 65-28, MS 74-18.

30. J.R. Thompson to McIntyre, 27 September, 1849, MS 65-28, Box 4, Folder 10. William C.H. Waddell, "A paper read before the American Geographical and Statistical Society, November 2, 1854," (New York, 1855), p. 28.

31. Three contracts for sales do exist: Between Elias Jones and Porteous, and Joshua Daniels and Porteous; 4 March, 1850, Envelope of Contracts, McIntyre Correspondence, THS. Daniels bought 220 acres.

32. McIntyre to Porteous, 12 November, 1845, MS 74-18, Box 1, Folder 2; 8 June, 1846, Folder 4; 6 October, 1848, Folder 5; Robert N. Cherry of Glens Falls, to Porteous, 9 July, 1849, MS 61-62, Box 3, Folder 12; McIntyre to Robertson, (draft on Robertson's of 8 June), 11 June, 1850, MS 65-28, Box 5, Folder 22; Thomas Shaw to Alexander Ralph, 4 March, 1852, MS 74-18, Box 1, Folder 5.

33. McIntyre to Porteous, 10 November, 1846, MS 61-62, Box 1, Folder 3; 17 April, 1847, MS 74-18, Box 1, Folder 5.

34 McIntyre to Alexander Ralph, 22 November, 1850, MS 61-62, Box 1, Folder 3.

35. Robertson to McIntyre, 25 December, 1850, 21 September, 1851, MS 65-28, Box 5, Folder 22, Dornburgh, (1885), p. 9, an employee during this time merely said Porteous left.

36. Dornburgh, (1885), p. 9; Masten, (1968), p. 111.

37. McIntyre to Robertson, 25 September, 1851, MS 65-28, Box 5, Folder 22.

38. Robertson to James McIntyre, MS 65-28, Box 5, Folder 13; M'Elroys Philadelphia Directory, 1854, p. 447.

39. Robertson to McIntyre, 13 June, 1850, MS 65-28, Box 5, Folder 22.

40. McIntyre to Robertson, 25 September, 1851, MS 65-28, Box 5, Folder 22.

41. J. R. Thompson to Sandy Ralph, 21 December, 1853, MS 65-28, Box 5, Folder 20.

42. McIntyre to J.R. Thompson, (Draft) 25 September, 1849, MS 65-28, Box 4, Folder 10; Robertson to McIntyre, 22 May; 8 June, 1850; McIntyre to Robertson, (Draft on Robertson's of 25 June), 27 June, 1850; 11 June, 1850; Box 5, Folder 22.

43. Laws of the State of New York, 1850, Chapter 333, Passed 10 April, 1850, pp. 728-9; Robertson to Younglove, 17 April, 6 May, 1850, MS 65-28, Box 5, Folder 21; McIntyre to Robertson, 11 June, 25 June, 1850; Robertson to McIntyre, 13 June, 26 June, 1850, Folder 22; McIntyre Correspondence, THS.

44. McIntyre to Ralph, 5 December, 1850, MS 61-62, Box 1, Folder 3.

45. McIntyre to Alexander McDonald, Aberdeen, Scotland, 7 June, 1851, MS 65-27, Box 35, McDonald Packet; Robertson to McIntyre, 6 June, 1851; McIntyre to Robertson, (Draft on Robertson's of 6 June), 9 June, 1851, MS 65-28, Box 5, Folder 22; Official Descriptive and Illustrated Catalogue, [Great Exhibition of the Works and Industries of all Nations], (London, 1851), Volume 3, Foreign States, p. 1455; New York Agricultural Society Transactions, 1851, Vol. 7:145.

46. "Advantages of the Works and Property of the Adirondac Iron & Steel Co..." (Philadelphia, 1851), p. 7.

47. Ibid., p. 8.

# CHAPTER IX

## The "New" Furnace

It was against this background of discouragement, financial difficulties, and an increasing willingness to sell the property that the company had embarked upon the largest single addition it was to build at Adirondac, the construction of a second and larger blast furnace. The genesis of the idea for this new installation was hazy. The earliest references to it came in April, 1848, in letters from Porteous to McIntyre. By that time, they had already considered and discussed building a new furnace. The plans had proceeded far enough for McIntyre to label Porteous's tests with fluxes that year as earmarked "for the present furnace." Moreover, the efforts to increase the water supply that year stemmed directly from the worry that the drought problems then being experienced might be greatly accentuated if a new furnace went into use.

> I am not a little surprised to hear you express the opinion, that the water power at Tahawus might possibly be deficient in a dry season to convert into bar iron all the pig metal that two blast furnaces could furnish. I had supposed that the vast basin of water formed by the dam there would be equal to, from 5 to 10 times the power necessary for the works you speak of. If you are right, it is clear, we shall be greatly short of power if we extend our Iron Works much.[1]

The decision to add a new furnace when the first one had never operated satisfactorily probably was made precisely because of the difficulties experienced with the 1844 stack. The owners had come to believe that the first furnace's operating deficiencies sprang in large part from the small size of the stack. Two additions in size had not produced any appreciable change, however. A.J. Rossi, the metallurgist, spent some time at Adirondac in about 1891 as part of his effort, at the behest of the McIntyre and Robertson heirs, to show that the iron offered an excellent commercial potential.

In the AIME Transactions where he publicized some of his findings, Rossi included sketches of the early furnace, made from notes that James MacNoughton, McIntyre's grandson, possessed. Those papers apparently no longer exist, and comments in the existing correspondence point up some possible contradictions. For example, Rossi indicated that Porteous altered the furnace only once, that the original height was 32 feet and later raised to 35 feet, and that the bosh in the enlarged furnace was 6 feet in diameter. These representations were all incorrect. Almost certainly, the original furnace was only a touch over 20 feet, although after two additions it may have reached 32 feet. The bosh size was 6 feet 11 inches after 1846, when the last changes occurred, not in 1848 as Rossi had written.

These troubling problems, cast great doubt on the accuracy of Rossi's figures. Still, the French metallurgist calculated that the first furnace held 430 cubic feet, with a hearth 2 feet in diameter and 5 feet 4 inches high, and a 5-foot bosh. The altered furnace, he assumed, had a 600 cubic-foot capacity, a hearth of the same diameter but only 2½ feet high. The bosh sloped at a steeper angle, running for 11 feet 8 inches from the top of the hearth to the 6-foot maximum diameter, instead of the 2-foot, 4-inch bosh wall in the original stack.[2] The owners were quite correct in their assumption that the ores alone did not explain the low output, and that the size of the stack accounted, in part, for the low production. But as discussed above, even compared to stacks the same size, the 1844 furnace had a dismal record.

A larger furnace, the owners hoped, offered not only the advantage of greater output, from the greater quantity of iron and charcoal it would hold, but also presented a possiblity for working the ore with less charcoal. A key point to remember was that every blast furnace possessed a temperment of its own, just as every furnace builder constructed his stacks with slight changes that he felt improved the operation of the furnace. So every furnace operator also ran things to suit his taste and experiences. Different furnacemen could achieve very different results from the same furnace. As U.S. Steel observed in its sourcebook, The Making, Shaping and Treating of Steel, blast furnace temperment has continued to be a part of the manufacture of pig iron.

> The blast furnace, even in its highest development, is by no means the even-going, easily regulated monster that the casual observer may take it to be. Although furnace operations are under better control now than ever before, furnaces are still capable of acting in unpredictable ways. Hence, a full discussion of this subject would be almost endless. There are few industrial operations wherein promptness of action, fore-thought and good judgement based upon skill and experience, are more needed than about a blast furnace in trouble. It is to be remembered that the operator must think six to ten hours "ahead" of the furnace, because any burden change will require that time to travel through the furnace and reach the hearth where its effect will be manifest.[3]

Porteous, Hodge, or any other furnaceman would no doubt have agreed with this summary. What the owners hoped was that the larger furnace would work more easily and produce more iron.

The key point in the decision to build the furnace was probably the chance to get more iron per year. At the time the initial talking began, it will be remembered, McIntyre worried that the steel works would run out of iron. Hodge's failure to improve the yield of the stack also served to prod the partner's toward the decision. The discovery that they could make steel seemed to presage the turnaround of the firm's fortunes. And as an assured iron supply became essential to the future of the steel works, the difficulties of the 1844 furnace became unacceptable. This one of McIntyre's main concerns.[4] And to reverse the reasoning, the steel works also gave the guaranteed outlet for the iron produced that justified the replacement of the cranky, older stack. By the time Hodge wrote his articles about the Adirondack Iron and Steel Company for the American Railroad Journal in October, 1849, the company had started building its second blast furnace.[5]

But very quickly, the optimistic outlook of 1848 changed to the caution of 1850. The company did not resume the construction work that year, in line with the effort to limit expenses to the minimum. Somehow, though, very few people seemed capable of abandoning such an impressive building project. As the modern experience has shown, once started, construction projects prove very difficult to stop, for they are too much fun to build. The second Adirondack blast furnace appeared to fall into this categroy. McIntyre had a much smaller role in the decisions about this furnace than in other features about the works. Yet although he wanted the expenditures stopped, he hedged his bets.

> I cannot conceive how we can go on and enlarge, unless perhaps that we must be compelled to do so, by the dilapidation of the old furnace and its wheel. Are not the wheels so decayed that they must be renewed? If that my be so, may it not be decidedly best to complete the new furnace?[6]

McIntyre's reasoning was intriguing, very modern and materialistic. Certainly repairing the decaying water wheels and reconditioning the lining of the old furnace would have been the least expensive option. Moreover, the steel works faced no shortage of iron. The steel works turned out only 163½ tons of pig iron in 1850. In 1851, the steel works had 300 tons of bar iron and 400 tons of pig on hand.[7] So the supply problem did not force the continuation of construction. Rather, it seems, the thought of the new magnificent furnace appealed to the partners, high cost or not. When it came to construction, a new set of buildings sounded better than simple repairs to the old. In fact, McIntyre seemed to give thought to litte, if any, repairs as an alternative. The origins of our throw-away society run deep.

Moreover, Robertson, the key figure among the stockholders as McIntyre became more infirm, seemed to relent in his cost-cutting resolve when it came to the furnace. In a letter on June 13th, he held out improvements to the works as the only reason to expend money that year and by improvements, Robertson meant the furnace. He wrote two weeks later:

> We may find it necessary, when I go there and see the state of things and consult with Porteous, to finish the new Furnace this season; although I would much prefer delaying it to another season.[8]

The result of Robertson's visit was a decision to continue the construction of the furnace. But from the tone of McIntyre's reply, that choice had been made even before Robertson left.

> I apprehend that you will find it necessary to finish the furnace so far as it can be done this year. Fire stone, fire brick, the bellows, temp stone, etc. etc., cannot go in until next winter, and therefore the furnace can not be finished until spring. But ovens must be erected and wood provided.[9]

So work went on, probably with the construction of the exterior stone shell of the furnace. Porteous also began to arrange for the numerous pieces of machinery and other supplies needed for the furnace to function properly. Some offers came uncolicited.

> I understand that you are building a new blast furnace by Mr. McCormick, and if that is the case, I should like to get the job of making your blow pipes and what other tin work you would want done. I will do the job as cheap as any one else can. I have worked at that business of making blow pipes, etc. for furnaces.[10]

For other parts, Porteous had to work harder. The primary equipment order he gave to the Hudson River Iron & Machine Company in Fort Edward, New York. That company formed in 1848, with a machine shop and foundry. The machine works quickly established itself as a supplier of a wide variety of castings and machinery, such as building a cotton mill with machinery in 1850. The machine company also had a relatively long existence, as it continued to advertise its products into the 1870s. One advertisement in the Washington County Business Directory in 1871 accurately capture the outlook of the Hudson River Iron and Machine Company, which was similar to many other small, all-purpose job shops that existed in most every town in the country.

> John Osgood, proprietor of
> Hudson River Iron and Machine Works
> Fort Edward, N.Y.
> Manufacturer of Valentine's Patent Turbine
> Water Wheels,
> and
> Circular Saw Mills,
> Machinery & Castings of every Description.
>
> All of my work is executed in superior style and will be sold at moderate prices. Mill Owners or others, in want of water wheels, shafting, gears, or other machinery will consult their interests by sending for circular and price list. Our wheels are without Doubt the Best in use.[11]

Porteous awarded the Hudson River Company the contract to construct the two waterwheels, the blowing cylinders, line shafting, and the stamps for crushing the ore. With that, and supervising the arrangements for getting the materials mentioned above by McIntyre, as well as carrying on the steel experiments and the continuing operation of the old furnace, Porteous had a full schedule.

The actual task of putting up the furnace must have continued, although very slowly, through 1851. But the actual pace can not be determined. From the correspondence, few supplies or materials appear to have gone into the works during the winter of 1850-51. The only certainty was that the Hudson River Machine Works did not live up to its contract. The machine company had pledged to start deliveries on the following schedule. "...the grudgeons for water wheel with boxes as early as 12 days from date of this, the segments as early as 3 weeks from this date, the balance by early sleighing or before the close of navigation..." As things actually happened, the water wheel and shafting pieces had arrived by the following winter, 1851-52. But the castings for the blowers were delayed for fully 2 years, not arriving until late January or February of 1854. The contract carried a penal clause of $500 for failure to meet the contract, but it is not known whether the iron works collected the money.[12]

The failure to deliver the machinery caused few initial problems, for 1851 must have been a lost year, as far as the new furnace was concerned. Porteous's departure was only one of the indications of the change in attitude that affected just how much was accomplished at Adirondac. Apparently the actual stack may have been completed, and the charging trestle erected with timber shipped from the sawmill at Tahawus. But the owners themselves remained unsure of their plans for the new addition. Ralph had to write to Robertson to prod him as what should be done during 1852.

> I received a letter from Mr. Brown with the resolution adopted by the Co. at their meeting. It seems to say nothing about the starting of the furnace next season, and I presume you are still undecided about it; but if you have any idea of doing so it would be a very great saving to provide a sufficiency of the articles of flour and pork this winter...[13]

The resolution that Ralph mentioned apparently told him to go slow on expenditures. He discharged twenty men, keeping only those with families. He planned to keep the family men either making charcoal, mining ore, or drawing logs to the mill. Ralph also got 9,642 firebrick in from Crown Point. E.L. Farrar had produced those, with their name stamped on each brick, for $35 per thousand. The freight charge of $3.25 a ton sounded more grievous than the actual cost of brick itself. All told, Ralph had ordered 15,000 brick.[14]

As spring rolled around, Ralph again pestered Robertson for instructions. Apparently he, too, hated to see the furnace stand unfinished. It was approaching the best working season, he wrote.

> There is not a great deal of work to be done to complete the furnace; the principal part of it will be to line the stack and put up the chimneys and hot pipes together with finishing putting up the balance of the machinery. The carpenters we now have will be able to do the latter part of it, and to finish the stack will require about two masons with their assistants; the extra number of men required will not be many, and as we have a abundant supply of provisions. I should not like them eat up without something being done to show for it; we have everything now on hand requisite for completing the furnace with the exception of the balance of machinery & cannot but think they will be here by the time we shall want them. If we line the furnace, I should like to send for Hiram Gibbs to do it and I think he can be got by letting him know before he is engaged in any other job.
>
> The large water wheel is finished except bolting on the cogs on the rim; we have also put up part of the line of shafting on the small wheel, and are progressing with the work rapidly. We have one more kiln of wood to coal here, which will finish all except about 500 cords left at the new furnace to be used without coaling. The new coal shed is now filled so that I think we have a stock of coal on hand almost sufficient for six months blast.
>
> There is as yet no appearance of the castings. I wrote some time ago to find out the cause of the delay, but did not get much satisfaction; their answer merely stated that they would start a team immediately with part, and would send the rest as fast as they could get them finished. I do not have any hopes of them coming in time enough for our teams to bring them in by sleighing, and should they come after that is gone, they must deliver them in here themselves, ...and at winter prices. I have not much doubt but they will be forth coming, as they run too much risk to delay us any longer.[15]

Ralph managed to complete some of the tasks he listed, but the lack of machinery held up other aspects of the construction. The masons had the furnace lined by July 10th, but could not work on the hot blast stove or chimneys, because the castings for the stove pipes had not arrived. The Hudson River Iron & Machine Company may have cast these retorts shaped like radiator pipes, but they were not listed on the original contract.

The hearth had not yet been started, either, for bed pieces - large sandstone blocks - continued to arrive in August. Without the machinery, it was obvious that Ralph could not complete the installation in 1852.

The work dragged on for another two years, partially because of the machinery delay. In 1853, the work stopped. Only at the end of the year did J.R. Thompson send up the galvanized sheet iron that formed the air receiver for the blowers. It came in two sizes, 48x20 inches and 72x24 inches, from 16 to 30 wire guage. Probably for ease of shipment, Ralph chose the smaller sized sheets, in a very heavy guage. It cost 1 shilling a pound - a high price. Finally, with the arrival of the last of the machinery in early 1854, the work of building the furnace was completed, and in August of that year, it went into blast for the first time.[16]

The long delay in delivering the machinery, however, was not the only reason the furnace took so long to build and get in operation. In fact, the iron works owners may have occasioned the delay themselves, by their desire to cut expenditures. As the correspondence made clear, after 1851, the company expended money only under protest. That the furnace was completed at all was an indication of Ralph's perserverance, and also of the momentum that a construction project can acquire. Also, the furnace, announced in the 1851 prospectus, became a selling point for the works, and had to be completed for that reason. But in other respects, the company withheld money.

Through early 1851, the correspondence reflected the usual activity taking place at the works for over 13 years; worries over supplies, arrangements to lease the saw mill at Tahawus, contracts for hauling clay, making hay, or providing charcoal.[17] There was still a sense of life in the village, enough so that Ralph hired David Goodale in March 1850 to be the doctor and to teach school. McIntyre had agreed to finance the installation of a weather recording station at the village, as part of a network of 6 stations the Regents of the State University wished to establish. The instruments included a good barometer, thermometer, rain and snow guage, and perhaps a wind speed indicator. Porteous was given the task of taking the readings.

Other events in 1850 included the erection of a boarding house, still standing in 1978, at Tahawus, and thoughts of bringing in bees for honey, and making maple sugar. Apparently, Shaw, the company's new clerk, had a sweet tooth. And the inevitable drinking incidents cropped up. One in June, 1851, was interesting, for it showed how liquor could get into the village. A peddler reached Tahawus in early June, and one of the employees agreed to sell the alcohol for him, claiming that he, the Adirondack employee, gained nothing from those sales. Shaw wrote that, "...he could not see why he chose to do what Morse the Peddler wished him to do, rather than what the Company wished. He does not say much, looks surly..."[18]

But with the dismissal of 20 men in November 1851, some of them having been there since 1838, most of the life went out of the village. Ralph could not have put the furnace into blast in 1851. If Porteous had run it in 1851 before his dismissal, not a very likely possibility judging from the figures on shipments from Tahawus for the winter of 1851-52, Ralph had blown it out when he assumed the superintendancy. The 1844 furnace did not produce iron after 1851.[19]

The belt-tightening had the desired effect, though, for in 1852, the expenditures plummetted from the previous levels. McIntyre paid $3985.13 for company expenses and paid a $2500 note for the firm. Robertson disbursed only $1393.26. But the place, apart from the people at the "New" Furnace, was quiet, and continued so through 1853, when little, if anything seems to have been accomplished. Sometime that year, the Reverend Henry Smith Huntington, a recent graduate of the Princeton Theological Seminary passed through the village. He described what he saw.

> By 6:00 p.m. we reached the Iron Works village, and stopped at the store in the place to procure a few necessities. The Iron Works are not now in operation. At one time more than 100 men were there employed and the little village alive with the din of trade. There are two factories - a mile apart; the new one has a mammoth chimney of unnecessarily heavy masonry. The fires are to be kept alive by three huge bellows worked by steam. In front is the hearth where the melted liquid flows out.[20]

That the tempo of the place had changed was best indicated by a letter from Ralph in 1852. Ralph, when the clerk, and Robert Clarke, during his short stay in a similar position, had taken advantage, like so many others since, of the hunting and fishing in the region. On one trip down the Opalescent River, the two men caught 113 trout in 7 hours, on a 5-mile section of that stream. But in March, 1852, it was hunting that attracted Ralph's attention. He had gone moose-hunting and got a "monstrous fellow". He had chased the moose for 8 miles with the dogs, finally cornering the exhausted beast near the Ausable ponds. Before Ralph had caught up with the dogs, the moose had nearly killed his pursuers.[21] The contrast with Porteous's struggles was apparent, for Porteous had trouble with employees going moose hunting. Never once did Porteous give any indication of indulging in any leisure activity - one gets the impression he was too busy for them. But Ralph, at least, had no difficulties finding the time.

While Ralph had time for hunting and fishing, the proprietors had devoted their primary attention to arranging the sale of the property. The 1851 prospectus and Crystal Palace success had no initial impact, and the meager correspondence for 1852 revealed no sales opportunities that year, either. Still, hopes for a sale seemed within reach, for the reputation of the iron's quality remained a potential drawing card, and had not been completely destroyed by the firm's difficulties. In April, 1853, George H. Cheney and Company from Toronto wrote to McIntyre, inquiring about purchasing iron for car wheels. They wanted 25 to 50 tons to start, and would use several hundred tons annually. The manager wrote, "...we have heard your iron highly spoken of for that purpose." And by December, 1853, Thompson had sold all of the iron on hand in Jersey City, and needed to find some at the works to fill an order in Troy.[22] The iron from Adirondac did seem to have a market.

Perhaps partially, for this reason, the prospects for a sale changed in 1853, as finally the company succeeded in attracting the serious attentions of a group of investors. The lack of activity at the furnace must have resulted from the apparent end to the partners' expenditures that a sale represented. By July, serious negotiations had advanced to the point of laying out terms. Only the iron works and the property in the north were sold - not the steel works, which had already been leased. Benjamin Butler, of Luzerne, was the interested party, who signed a contract of intent on July 27, 1853. For $570,000 the company planned to convey 104,510½ acres of property, all the works, the bank, any surveys, and existing contracts. The partners held out only 23 tons of iron at the works. Butler was to have $500 ready by September 30, making 10 annual payments of $56,000 at an interest rate of 4%. However, if the New Jersey Supreme Court refused to sanction the sale of the portion of the property owned by the minors in David Henderson's estate, Butler had no obligation to continue with the purchase.[23]

Probably the single most important reason Butler was willing to buy the company was the formation of the Sacket's Harbor & Saratoga Railroad in 1849. The road made scant progress over the next years, but by October, 1853 the engineer had a report on the different routes traversing the distance between Saratoga Springs and Lake Ontario. It was not coincidence that the sale of the company took place just as the railroad began to move forward with the selection of its right of way. Finally, the possibility of getting adequate transportation to the works existed. The contract between Robertson and the Sacket's Harbor & Saratoga Railroad, signed February 1, 1854, showed how important the potential artery was to the works. In the agreement, endorsed by Butler, the iron works agreed to transfer 19,002 acres of land to the railroad if it had succeeded in constructing a line as far as the confluence of the Boreas and Hudson Rivers within 5 years. Unfortunately, in the 19th century a rail link never reached Adirondac or any part nearer than North Creek.[24]

One can imagine the elation on the part of McIntyre and Robertson at their success, at long last. Unfortunately, the sale itself did not go off with the same smoothness as the initial contract arrangements had. On September 16, Butler wrote to McIntyre to be sure about the sale, primarily to find out whether the Henderson heirs could sell. McIntyre reported that he and Robertson were ready, although Henderson's estate would have to sell later. Butler probably did not like this arrangement, for September 30 passed without a sale being recorded. Instead, a series of letters from October 10, to January 14, discussed a search of the tax and assessment roles in Elizabethtown, Essex County by Butler and James McIntyre to clear the way for the sale. Before the sale could go forward, all back taxes had to be settled.[25]

From this point, the story became more confusing, even for the company. After McIntyre's death, the Iron Company and heirs became involved in a lawsuit over whether the company retained valid control over the property, or whether McIntyre and Robertson had personally conveyed the property in this sale, thus invalidating the corporation's existence. The company won that suit, but the records did not indicate whether Butler actually made the first payment. The settlement of the lawsuit would indicate that Butler never made the payment. Moreover, through May and June, Younglove negotiated with General Lyman for a sale, never consumated. Then on 26 July, exactly one year after his initial agreement, Butler turned his contract over to Stanton & Wilcox. Butler and others may have tried to raise the necessary capital, but failed. In 1854, another prospectus appeared with Butler, Lyman and Younglove, and the attorney listed as directors. Clearly, they intended to attract attention, probably with the intent to sell shares. Unfortunately, the prospectus merely adds to the confusion. While published after July 26, 1854, it made no mention of Stanton & Wilcox. The correspondence, however, was reasonably clear that Stanton & Wilcox were indeed in control of the property through the remainder of 1854.[26] The result was that the new owners were the first to actually operate the "new" Furnace.

## Notes

1. Porteous to McIntyre -- 18 April, 29 April, 1848, MS 74-18, Box 1, Folder 5.

2. Rossi, (1892), p. 836.

3. The Making, Shaping and Treating of Steel, p. 466.

4. McIntyre to Henderson (2nd), (Draft on Henderson's of 21 July) 22 July, 1848, MS 61-62, Box 1, Folder 5.

5. Hodge, (1849), p. 623.

6. McIntyre to Robertson, 17 June, 1850, MS 65-28, Box 5, Folder 22.

7. Account sheets, F Misc. File, McIntyre Correspondence, THS; "Advantages of the Works and Property of the Adirondac Iron & Steel Co. ...", p. 6.

8. Robertson to McIntyre, 26 June, 1850, MS 65-28, Box 5, Folder 22.

9. McIntyre to Robertson, (Draft on Robertson's of 26 June), 27 June, 1850, MS 65-28, Box 5, Folder 22.

10. A.M. Pond, Ticonderoga, N.Y., to Porteous, 15 June, 1850, MS 61-62, Box 3, Folder 12.

11. Agreement with Hickok and Mears, Machinists, Fort Edwards, N.Y., 15 August, 1850, McIntyre Correspondence, THS; Crisfield Johnson, History of Washington County, New York, (Philadelphia, 1878), pp. 319-20; The New York State Business Directory, (Albany, 1874), p. 1227; New York State Business Directory, (Syracuse, 1876), p. 1111; Gazetteer and Business Directory of Washington County New York for 1871, (Syracuse, 1871), p. 250.

12. Agreement with Hickok and Mears, THS, Ralph to Robertson, 18 March, 1852; 10 July, 1852; Ralph to John Cheney, 23 November, 1851; MS 65-27, Box 40, Ralph Letterbook; Sales Agreement, Adirondack Iron & Steel Company with Benjamin Butler, 27 July, 1853; McIntyre Correspondence, THS; McIntyre to Ralph, 14 January, 1854, MS 61-62, Box 1, Folder 3.

13. Thomas Shaw, Tahawus, to Ralph, 17 June, 1851, MS 61-62, Box 3, Folder 13; Ralph to Robertson, 29 November, 1851, Ralph Letterbook, MS 65-27, Box 40.

14. Ralph to Robertson, 29 November, 1851, Ralph Letterbook, MS 65-27, Box 40. Ralph to Russell Root, 19 January, 1852; Ralph to E. L. Farrar, 18 March, 1852; Ralph to Robertson, 18 March, 1852, MS 65-27, Box 40, Ralph Letterbook.

15. Ralph to Robertson, 19 March, 1852, MS 65-27, Box 40, Ralph Letter-book,

16. Ibid., 10 July, 1852; Shaw to Ralph, 14 August, 1852, MS 61-62, Box 3, Folder 3; Thompson to Ralph, 21 December, 1853, MS 65-28, Box 5, Folder 20; "Adirondack Iron & Steel Company," (New York, 1854), p. 41.

17. Shaw to Ralph, 25 Ocotber, 1850, 21 March, 10 June, 22 February, 1851, MS 61-62, Box 3, Folder 13; Contract between Henry Dornburgh and Alexander Ralph, 16 June, 1851, MS 74-18, Box 1, Folder 10.

18. Porteous agreement with Goodale, 22 March, 1850, MS 61-62, Box 3, Folder 12, McIntyre to Robertson, (Draft), 11 June, 1850, MS 65-28, Box 5, Folder 22; Shaw to Ralph, 17 November, 1850; 3 January, 8 March, 17 June, 1851, MS 61-62, Box 3, Folder 13.

19. Balance of the Books, 30 October, 1852, F Misc. File, McIntyre Correspondence, THS. The last mention of the 1844 blast furnace in the correspondence came in McIntyre to Robertson, (Draft), 27 May, 1850, MS 65-28, Box 5, Folder 28. McIntyre assumed that the furnace was repaired and back in blast. Later visitors reported it abandoned. Henry Jarvis Raymond, in Hochschild, "Addendum to Chapter 13," Township 34, (Syracuse, 1952,1953), p. 170H.

20. Account sheet, 31 December, 1852, MS 65-28, Box 2; Henry Smith Huntington, "Adirondack Diary - 1853," New York State Conservationist, Vol. 5 (August-September):23.

21. Robert Clarke to his mother, 17 August, 1850, MS 61-62, Box 3, Folder 15; Ralph to Robertson, 18 March, 1852, MS 65-27, Box 40, Ralph Letterbook.

Clarke had a keen interest in natural history, which he exercised to the full at Adirondack. In a famous letter to the Western Academy of Natural Science in Cincinnati, Clarke gave a good account of the flora and fuana of the region, as well as an interesting description of ice fishing and reviving the frozen catch. Masten (1968), pp. 116-24, reprinted the entire letter. Clarke to the Western Academy of Natural Science, 15 March, 1852, MS 61-62, Box 3, Folder 15.

22. John H. Richey, proprietor of George H. Cheney & Co., to McIntyre Iron Works, 22 April, 1853, MS 61-62, Box 3, Folder 12; J.R. Thompson to Alexander Ralph, 21 December, 1853, MS 65-28, Box 5, Folder 20.

23. Contract between Benjamin Butler and the Adirondac Iron & Steel Co., 27 July, 1853, McIntyre Correspondence, THS.

24. See A.F. Edwards, "Report of the Different Routes and Estimates of the Sacket's Harbor and Saratoga Railroad," (New York, October, 1853). Contract between Adirondac Iron & Steel Company and Archibald Robertson, 1 February, 1854, MS 61-62, Box 1, Folder 5.

25. Butler to McIntyre, 16 September, 1853; McIntyre to Butler, 19 September, 1853, MS 61-62, Box 2, Folder 6; Younglove to Ralph correspondence, MS 61-62, Box 1, Folder 3.

26. Memorandum in relation to title to Adirondac, ca. 1861, MS 65-28, Box 2

# CHAPTER X

The furnace complex that Stanton & Wilcox inherited some time in August, 1854, represented the largest single addition to the village of Adirondac. The builders had selected a site one mile south of the village for this installation. The location stood at the furthest reach of the navigable water on Lake Sanford, brought about by the dam built at the Lower Works. A wharf and crane at the furnace facilitated the movement of timber, lime, and stones from Tahawus and loaded iron for the trip south. The company maintained a fleet of six boats on the Lake, the largest of which was of 50 tons burden, another of 20 tons, and four smaller craft. They may have been steam-propelled. The names of two of these craft were the McIntyre and Experiment. The latter, certainly, was the most apropos.[1]

The actual iron smelting operation involved the construction of the blast furnace and charging bridge, casting house, coal sheds, a wheel house and carpenter shop. Obviously, the 45-foot high stone furnace stack dominated the scene.[2] Reaching out to it from the adjacent hillside was a wooden trestle called the charging bridge. The trestle was boarded over for protection from the elements, and a frame structure called the tophouse covered the entire top of the bridge. Here some materials were stored before charging into the furnace. The chimneys for the hot blast stove protruded through the roof of the tophouse, and a covered, contilevered cat walk gave the topmen access to the damper controls on the front of the furnace. The ore stamps, a set of 12 drop stamps also stood under the roof of the tophouse. A long line shaft and leather belt arrangement powered this machinery for crushing the ore. On the hilltop at the end of the tophouse stood two large coal houses, approximately 100 feet long by 20 to 30 feet wide. An 1854 accounting listed 250,000 bushels of charcoal in these sheds.

A casting house, also of frame construction, stretched out before the hearth arch of the stack. There, the furnacemen ran the molten iron out of the furnace into molds formed in the sand floor of the room. The trough that carried the iron was the sow, the filled molds were known as pigs, hence the name pig iron. A clerestory monitor ran the length of the roof to provide some ventilation, but the temperatures in the casting house must have been unbearable during the summer.

At the east end of the casting house was a rough road for the removal of slag and the pigs. An overhead trestle spanned this path, connecting the casting shed and the carpenter shop; it also carried the line shaft to the ore stamps and the blast air main to the hot blast stove. These last two must have run along the north wall of the casting house.

The carpenter shop stood directly adjacent to the wheelhouse, located on the bank of the Hudson River. The wheelhouse contained two water wheels, and all of the blast machinery. The larger wheel was an overshot, 16 feet 4 inches in diameter, and 17 feet 9 inches across the face of the buckets. The buckets were divided into four sections by iron bands. Spokes morticed into the 18-inch wooden shaft supported the wheel. Wrought iron tie rods pulled the whole wheel together. Gudgeons on the end of the axle supported the wheel as it rotated in open bearings lined with babbit metal. This wheel drove two crankshafts via external segment gears. Each crankshaft in turn propelled a pair of horizontal cast-iron blowing cylinders. This blowing engine provided more blast volume than was necessary. Each cylinder alone could have provided an adequate volume of air for the stack. A galvanized sheet iron air receiver four feet in diameter and 20 feet long straddled the blowing cylinders. The receiver's purpose was to even out the blast, by maintaining a constant flow to the furnace. Acting as a storage container, it allowed pressure to build up in order to keep air moving even through the dead spots in the blast, as a piston reversed direction. A galvanized air main carried the air across to the casting house and up to the hot blast stove. After passing through the stove, the heated air entered the furnace via three water-cooled tuyeres.

The smaller wheel was only six feet across the face of the buckets, but had the same diameter, and bucket construction. This wheel rotated on a cast-iron axle, with spiders supporting eight spokes, again morticed into the shroud on the wheel's rim. A single segment gear enabled the wheel to transmit power to the line shaft for the stamps. This wheel also ran a water pump that circulated cooling water to the tuyeres and dam and tymp plates at the furnace. A leather belt turned this centrifugal pump, a Gwynne patent model made by the Union Power Company in New York.[3]

To enable winter operations to go on, a frame structure covered the wheel house and flume that fed water onto the wheels. Dormer windows admitted light to the machinery area. The dam behind the wheel house was a stone structure, about 25 feet high that stretched for some 180 feet across the river. Almost certainly the winter face of the dam had a timber front, and an apron of beams prevented water from undermining and overturning the dam on the downstream side.

This assemblage of buildings sounded very impressive, especially when the list of facilities at the village and the Lower Works were included in the 1854 Prospectus published by Butler and others. That document made the "New" furnace sound like the center piece of a vast iron-working establishment. The prospectus listed the following structures at the Upper Works, in the village itself.

> Upper works - village called McIntyre, and sometimes "Adirondac." Buildings owned by company.
>
> 1 Cupola Furnace; 1 Blast Furnace; 1 Forge and Puddling Furnace; 1 Stamping Mill; 1 Mill for driving small machinery; 1 Saw Mill; 1 Grist Mill, or mill for grinding feed; 1 Hay Scales, 2 kilns for roasting ore; 1 Brick House; 1 Granary; 1 Tool House; 1 Blacksmith

> shop; 1 Carpenter shop; 3 Coal kilns; 6 Coal Houses; 1 Long Wood House; 1 store for Merchandise; 1 Ice House; 1 Powder House; 1 Large Boarding House; 16 Dwelling houses for workmen; 1 School House; 3 Large barns; several cow stables and Cattle Sheds; 1 Piggery; 1 Building with Steaming apparatus.

The facilities at Tahawus included:

> Called Tahawus - Here the company have erected a new dam, one thousand seven hundred feet long, at a cost of $19,000, with a water power having a fall of 24 feet. Here also is a dock and crane for loading and unloading freight. The buildings here are as follows: 1 Warehouse for merchandize; Iron Warehouse; 1 Blacksmith Shop; 1 Saw Mill; 1 Large Boarding House, with large barn and sheds; 3 Dwelling houses for workmen; 1 School house; 1 Lime Kiln.[4]

Finally the prospectus mentioned the two farms, 3,000 tons of ore, firebrick, and tools, 150,000 feet of timber with logs in booms, and the "New" furnace itself. But this description contradicted the reality of the situation. By 1854, few workers remained at the village, and even fewer of the original facilities were operable. Only the charcoal kilns, sawmills and perhaps the forge at the village were being run by the time Stanton & Wilcox took over. So, rather than the high point of the Adirondack Iron and Steel Company's development, this last addition might better be viewed as a last gasp effort to gain the attention of buyers.

As the last chapter showed, there was not a clear continuity between the first and second blast furnaces. The dismissal of Porteous was only the clearest indication of the change in outlook that separated the 1840s and the 1850s. As a result, the "New" furnace presented a number of contradictions. That it was even completed ran against the owners' unwillingness, so manifested after 1851, to invest further time or capital in their northern venture. At a time when McIntyre took Clarke and Ralph to task for buying too much sugar and too many raisins, the company spent as much as $43,000 on this new installation. Furthermore, the owners appear to have had little intention of ever producing iron from the furnace. The correspondence left the impression, after 1851 at least, that if the "New" furnace was ever to operate, the original owners would not be in charge.

Yet against this background of discouragement, doubt, and pessimism, the furnace they constructed exemplified the awareness of technical changes within the iron industry that had been a hallmark of Henderson's attentions. Their desire to dispose of their holdings to outside investors can only partially explain the obvious concern for the installation of up-to-date machinery. Perhaps the inherent momentum of the project itself accounted for attention to details. Whatever the motivation, the result was a blast furnace that captured the American iron industry in the midst of those important changes in technology.

During the 1840s and 1850s, anthracite coal had slowly replaced charcoal as the fuel used in blast furnaces. In 1855, for the first time blast furnace operators produced more iron with stone coal than with charcoal. Such a change entailed more than the simple substitution of one fuel for another. A whole series of technical and operational changes accompanied the introduction of the new fuel, and in fact made smelting with anthracite possible. Primarily, anthracite fuel demanded a higher furnace temperature than charcoal. To work well, the air blast had to be stronger and pre-heated in order to attain the necessary temperature. Different types of blowing engines and hot blast stoves developed during this period enabled furnace owners to use anthracite fuel.

The Adirondack Iron and Steel Company's "New" Furnace presented an intriguing glimpse of the transition in progress. While it continued to use charcoal, the owners nonetheless adopted features and equipment for their installation from those developing for anthracite furnaces. Thus the influences of the old and new technologies affected the design of the "New" furnace. From the choices made, it seems clear the decision-makers exercised a careful and thoroughly thoughtful approach, picking and choosing components that matched the needs and characteristics of their site. While obviously conversant with the new techniques available, the partners did not build a complete state-of-the-art furnace. Instead, careful compromises demonstrated the intelligent forethought characterizing this installation.

Amazingly, all the major technical features of the site have remained basically intact, undisturbed since the furnace ceased operating. Ironically, the isolation of the village that caused such great difficulties for the company, has saved the equipment from the scrapyard and tourists. As a result, the furnace over which Stanton & Wilcox assumed control has suffered littler alteration during the intervening 124 years.

This fortuitous occurence highlights the way in which the "New" Furnace reflected both the traditional charcoal-related technology and the new mineral fuel features of iron manufacturing. In general layout and appearance the new furnace resembled most charcoal furnaces built in this country. The stack was located at the foot of a relatively steep hill to reduce the size and length of the charging bridge. Not until mechanical arrangements for conveying materials to the charging hole were developed later in the century did the charging bridge disappear as a blast furnace feature.

The entire arrangement of the village itself resembled the traditional iron plantation, a self-contained unit producing crops as well as iron The rural isolation of many furnaces demanded that owners supply housing, farms, and stores if they were to recruit a labor force. Conversely, the voracious charcoal appetite of the iron-making process all but demanded rural location with a large acreage of forest lands, at least in the ante-bellum era that lacked adequate bulk transportation capabilities.

Yet in a number of other respects, the influence of the new techniques lay heavy on the Adirondack Company's second furnace. The physical appearance of the stack would not have aroused any excitement, for as Frederick Overman observed in his 1850 treatise on iron making, "The outward form varies greatly; and every owner or builder follows whatever arrangement is most comformable to his taste."[5] The second furnace was of local amorthosite stone, a gray rock in which the ores occurred. But in two important respects, the second furnace reflected the new anthracite-inspired features. First, the stack reached 45 feet into the air, a significant increase in height. While charcoal furnaces had averaged about 30 to 35 feet, anthracite and coke fuels enabled furnace builders to stretch furnace heights to 100 feet and more. For one thing, coke and coal did not crush under the greater weight of the heavier burdens in a taller furnace. But this explanation only partially explained the lower height of charcoal stacks, for in the post-Civil War era, advanced charcoal-fueled furnaces reached 60 feet.[6] More important may have been the extra demand for charcoal that larger furnaces entailed. As Schallenberg and Ault pointed out in their article in Technology & Culture, improved methods of charcoal production raised the yields per cord of wood, and developed coincidentally with the larger charcoal blast furnaces.[7] But for smaller operators, increasing mineral coal production remained a simpler and less expensive option than increasing wood charcoal output. Moreover, charcoal production took more time than mining coal.

The key point was that anthracite coal as a fuel and taller furnace stacks appeared at the same time. The Adirondac "New" furnace copied this trend. The builders of this second furnace also borrowed from the larger furnaces the use of wrought iron tie rods to reinforce the exterior masonry shell of the stack. The expansive forces caused by the high heat needed to produce molten iron inevitably took its toll and ultimately could reduce a furnace to rubble. The pile of stone that marks the site of the 1844 furnace offers ample evidence of the problems furnace builders encountered. The tie rods, or binders, helped to strengthen the masonry. But as observed in The Making, Shaping and Treating of Steel, only larger furnaces adopted this innovation, although by 1850 Overman recommended the incorporation of binders in furnace construction.[8] The larger size of the mineral coal furnaces and higher temperatures pushed this innovation along.

The Adirondack Company adopted the use of binders in a big way. Not only did 10 rods reach across each face of the stack, but the builder also added 7 sets of 8-sided bands that cut through the corners, running to a face plate on each wall of the stack.[9] These rods encircled the furnace for greater strength.

The interior design of the furnace also reflected the changing methods of iron manufacturing. Traditional charcoal blast furnaces had an interior shape resembling two truncated cones, with their bases meeting at the widest point of the furnace, called the bosh. The bosh diameter was quite large relative to the furnace height; this prevented the burden from clogging the stack. The higher temperatures of coal furnaces however, made the burden more fluid and eliminated this danger. Thus the larger furnaces needed a smaller bosh to height ratio. As a result, the interior walls could be constructed at much steeper angles. Again, the Adirondac second furnace exhibited this change.

These modifications in furnace design apparently came into use quite rapidly after their introduction in the late 1830s. By 1850, Overman could write:

> At the present time, the blast furnaces are reduced, in a greater or less degree, to a general principle. While they slightly vary according to ore, fuel and locality, in all of them the hearth is narrow and high, the boshes more or less steep, and the trunnel head, or throat, from twenty inches to four feet wide.[10]

This description quite aptly matched the "New" furnace, indicating that the Adirondack Iron and Steel Company was not the only firm aware of new developments in its field. But the excellent preservation of this undisturbed furnace graphically showed the features Overman described.

Moreover, the machinery installed at the "New" furnace gives further evidence of the new technical devices appearing in the iron industry. Incredibly, most of the machinery has remained intact at the furnace site, so that the Tahawus, New York location may boast the only surviving examples of a blowing engine and hot blast stove, of their types. (Despite a century of neglect, this equipment was in quite good condition in the summer of 1978, although attention will become an increasingly pressing demand in the near future.)

The blowing engine was the heart of the mechanical facilities at any iron smelter, and from the blast of air this equipment produced the furnace took its name. By the 19th century, the large leather bellows, like those found at Saugus, Massachusetts, had given way to wooden blowing tubs. Usually operated in tandem, a water wheel powered a pair of single-acting piston that forced the air into the furnace. The 1844 furnace had such equipment. The introduction of anthracite again led to changes, because of the need for a stronger blast. The steam engine as a motive power source and horizontal, double-acting iron blowing cylinders became the standard solution at coal-fuel furnaces.

With the blowing engines at Adirondac, the observer can best see the careful consideration given to the choice of equipment. The contract Porteous signed with the Hudson River Iron and Machine Company called for the fabrication of four cast-iron, horizontal cylinders to provide the blast. As Overman commented, such an arrangement was "...very much used in the Eastern States."[11] But the proprietors chose not to install the other half of this innovation - a steam engine. Why they made this decision was never explained, but it was perfectly logical to continue to rely on water power from the Hudson River. By choosing a site downstream from the village, they vastly lessened the worries about an adequate water supply. Instead of six water wheels, the river had only to turn the pair in the wheelhouse.

Overman argued;

> There is no reason whatever for employing water power in the propelling of blast machines at blast furnaces. There is abundant of waster heat for the generation of steam. The expense of erecting a steam engine will be found less, in most cases, than that incurred in the erection of a water wheel.[12]

Nonetheless, the company retained water power to drive the cylinders. And while this choice would seem to have indicated a conservative tendency, it actually represented a rational choice for the Adirondack company's new furnace. The use of water power indicated the manner in which the company tried to fit the technological innovations to its situation. The wheel house could draw on the entire flow of the Hudson, as it stood a mile south of the village and the other water wheels. And while water problems had been a worry in the past, actions since the mid-1840s had increased the flow of water. Most importantly, the wheel was built and maintained by local people. The owners did not have to find skilled outsider to run a steam power plant. The wheel also needed no wood to fire a boiler. Wood was abundant, but feeding a boiler would have added yet another demand for timber to the existing list. So the choice of water power represented a carefully thought out decision, where the technical solution matched the needs and capabilities of the site. Equally so, the adoption of horizontal iron blowing cylinders demonstrated the owner's awareness of new trends. The combined system seemed to work quite well.

The hot blast stove was the other anthracite-inspired innovation installed at Adirondack. The 1844 furnace had also been equipped with a pre-heated blast arrangement, so the use of such equipment on the "New" Furnace was not surprising. Still, the rapid acceptance of this invention marked the progressive outlook of the firm's owners. While hot blast emerged as a necessity for coal furnaces, it offered benefits to charcoal furnaces as well. Primarily, hot blast improved the efficiency of the furnace by channelling the waste gases into a brick stove located on top of the furnace. Here, it heated a set of cast-iron pipes, called retorts. The blast air circulated through these V-shaped retorts before entering the furnace, having been heated to a temperature as high as 600°. Thus, less charcoal had to be used to heat the blast, reducing the amount of charcoal needed per ton of iron. Overman reported that the use of hot blast lowered hard charcoal consumption by 20%, and reduced the time 50%. The most drastic savings occurred with coke and anthracite, which saw 30 to 60% savings of fuel.

James Neilson of Great Britain had patented the first hot blast stove in 1828, and the new furnace used a typical Neilson stove. As J. R. Johnson observed in 1917, "...a type of construction was evolved which was almost universally used."[14] The "New" Furnace was no exception to this pattern, but its stove may be the only surviving example of its type.

The adoption of the hot blast, however, led to other changes in a way that indicated why a technological change is rarely accomplished by mere substitution of parts. Hot blast, furnacemen learned, raised the temperature of the furnace at the nozzle of the tuyeres and they tended to melt. A water cooling arrangement became essential at hot blast furnaces. A water jacket penetrated by a spiral path for the circulation of water was devised to keep these cast iron nozzles cool. Similar adaptations were fitted to the dam and tymp plates, iron plates that covered the exposed hearth stones where furnacemen's tools could reach into the hearth. So long as the water flowed, and proper attention was paid to the blast, the cooling arrangement adequately protected the tuyeres. But as the correspondence and melted tuyeres found at the site bore witness, the tuyeres could still melt. Thus, while hot blast offered advantages in terms of improved fuel efficiency, this innovation added further complications to the furnace equipment: a water circulation system, with pumps and piping. The changes no doubt paid for themselves in charcoal savings, but did increase the complexity of the process.

The long list of anthracite-inspired modifications that appeared at the "New" furnace demonstrated not only that the pace of change in the iron industry had begun to accelerate, but also that people such as the owners and furnace builders at Adirondac were willing to adopt the changes almost as quickly as they appeared. Unfortunately, the key figure behind the design of the second furnace has not revealed himself to the researcher. Indications in the correspondence hinted at Porteous's early role in determining the machinery at least, but how much input Robertson or McIntyre had is unclear. Ralph must have played some part in the later stages of the construction, but the anonymous masons and millwrights probably accounted for most of the layout and appearance decisions at the site, and perhaps for much more.

But while the persons responsible for making the decisions cannot be identified, guesses can be made as to where they obtained their design ideas. One possible source lay in the published manuals, textbooks, and treatises of geology and mineralogy. The iron industry has usually been viewed as an empirical trade. Clearly, the accumulated experience method of learning marked most of the advances at Adirondac as well. But the owners penchant for turning to published scientific sources also had played a major role in all of their building and experimental efforts. The "New" furnace was probably not an exception to this rule. Several times in their letters the owners mentioned books or articles they had read in the course of their efforts to make iron more easily at Adirondac. Before David Henderson's death, he had written about looking at Mushet's treatise on iron making. McIntyre's will listed the books in his estate, over 90 volumes, including Bakewell's Geology, Cleveland's Mineralogy, Phillip's

Mineralogy, Nicholson's Mechanics, eight volumes of the Journal of the Franklin Institute, Overman's treatise, and Taylor's work on coal.[15] These titles portrayed not only the partners's scientific approach, but also may have guided many of their decisions about the furnace and its attendant apparatus.

In examining Mushet and Overman now, the reader can discern several coincidental features, possibly indicating that the proprietors took their ideas from this published material. For example, Mushet in 1840 published a set of plates and a description for a 45-foot high furnace, with a 12-foot bosh diameter, and a Neilson-type hot blast stove. The second Adirondac furnace neatly matched those dimensions, and utilized a Neilson stove. In Overman, also, resemblances existed between the equipment he portrayed or described, and that erected by Porteous and Ralph. The list was quite long; Overman portrayed a furnace with 10 tie rods on each face, just as built at Adirondac, although Overman did not show the octagonal bands added to the second furnace. These binders also were secured with wedges on Overman recommended. The tunnel head, or charging hole, at Adirondac was four feet in diameter, matching Overman. The brick chimney over the tunnel head, the use of fire brick inwalls for furnace lining, the stone fragments adopted as a fill behind the brick lining, and the installation of iron plates around the tunnel head all fitted Overman's instructions. The blast pipe feeding the tuyere might have been copied directly from one of Overman's illustrations with its poker and mica view screen. The blowing cylinders, as mentioned above, resembled those shown in his treatise, as did the sheet iron air receiver. The receiver was the size recommended, four feet in diameter, and equipped with a manhole for access. Finally, the choice of sheet iron for the fabrication of the blast air main agreed with Overman's instructions.[16]

Just what role Overman and Mushet played in the designing of the "New" furnace cannot be known. Especially, in the case of Overman, resemblances may merely have resulted from the builders's use of common and wide-spread practices that Overman had observed. But it is still worth noting how closely the Adirondack Company's second furnace resembled those shown on the pages of Overman's treatise.

Another influence probably existed in the design of other furnaces in the northern New York region. The letters contained no confirmation of the type of cooperation between firms that had marked the construction of the 1844 blast furnace. But the close similarities between the second stack and others erected along the western shore of Lake Champlain at this same time indicated that the various owners were drawing ideas from a common pool of knowledge. For example, the 1846 Sisco Furnace at Westport, New York stood 44 feet high with a 13-foot bosh diameter, using two cast-iron blowers. The Crown Point Iron Company and Jonas Tower erected a furnace 45 feet high with a nine-foot bosh in 1845. The Fletcherville Furnace built in 1864-5 was 42 feet high with an 11-foot diameter bosh. All of these furnaces used Neilson- type hot blast stoves as well.[17] The previous developments at Adirondac had demonstrated that the Company did not operate in a vacuum, but rather paid close attention to the processes and arrangements in use at other iron works. Quite clearly, the "New" furnace was a very typical blast furnace for its time and location.

Even if no formal contacts occurred between Porteous and Ralph and their counterparts at the other local furnaces, an avenue for the transmission of similar features remained open. The masons and millwrights probably were the most important decision-makers in the design. Always, when the time for expansion arrived, the partners turned to outside masons and millwrights. These men from Crown Point and Port Henry also built, maintained, or altered most all of the furnaces in that vicinity. The actual constructors of the "New" furnace probably were hired in much the same way as those who had built the 1844 furnace. Certainly these men did not live at Adirondac, but traveled to the work. The individual contributions of these skilled hands can only be guessed at, but hints of their presence remained. The dressed corner stones on all four sides of the furnace and at each archway told of a concern for appearance; the edge is straight as a ruler. Some mason took extra care with the brick lining of the archways, with its fascinating pattern that followed the rising ceiling. The castings for the machinery also exhibited excellent craftsmanship, as in the connecting rods, cylinders, and cross-head guides on the blowing engine. The cast-iron blast pipe connecting the tuyere and the blast air main, or bustle pipe, was especially well done. The floor of the wheelhouse demonstrated not only careful construction, but a desire for permanence that belied the owner's desires to be rid of the property. The wheelhouse was layed out so that the water exited from the wheel pit under the machinery floor via three tunnels. Each tunnel was five feet wide and over three feet deep. Two piers, also five feet wide formed the walls that split the exitway into three tunnels. The piers supported the stone slabs that in turn supported the machinery floor, each slab being about ten feet long, a foot thick, and almost three feet wide. On these slabs were piles a foot of rounded river stones, and a layer of cement, all of which combined to securely anchor the machine into place. Because of the solidity of this floor, and the careful construction, by 1978, the only movement of the machinery has been occasioned by the rotting of supporting timber cribs.[18]

The author of this plan, and other features of this furnace just cannot be determined from what is presently known. If the pattern of other construction at Adirondac had been followed, the millwright or mason had a major role in determining features like the wheelhouse floor, or the brick pattern of the furnace arches. What does seem apparent was that the owners knew what was happening in the iron industry, and at nearby works. The combination of this knowledge with the skills and abilities of the craftsmen who actually erected the buildings and machines resulted in a typical 1850s charcoal furnace, one still in a remarkable state of preservation.

## Notes

1. Information drawn from Adirondack Iron and Steel Company, (New York, 1854), pp. 41-2, and Official Descriptive and Illustrative Catalogue; Great Exhibition of the Works and Industries of all Nations, (London, 1851), Vol. 3:1455-6; Thomas Shaw to Alexander Ralph, various letters, 1850-52, MS 61-62, Box 3, Folder 13. The McIntyre was 47 feet long, with a beam of 12 feet five inches at the bow, tapered to 13½ feet at a distance eleven feet from the bow. Shaw mentioned a single mast, and no steam engine.

A visitor later in the decade mentioned a "noble twelve-oared pleasure boat belonging to the Iron Company." T.A. Richards, "The Adirondack Woods and Waters," Harper's New Monthly Magazine, (August-September, 1859(:461.

The remains of one of the barges still can be found in the river a short distance below the iron works.

2. See HAER site plans and photographs for a graphic presentation of the site's layout. Photographs 8 to 14 show the stack of various times-#8 and 9 are 1870s-1880s era views.

3. The Gwynne pump was patented in 1851 by James Gwynne. He exhibited it at the London Crystal Palace that year. It came in sizes ranging from 25 to 100,000 gallons per minute. At the 1853 New York Crystall Palace, three Gwynne pumps operated, one powering a fountain in the main concourse, another running a fountain in a glass ball while filling fire tanks, and a third spraying a fountain of cologne in Mr. Phalon's Bower of Perfume. Gwynne's centrifugal pump claimed to be unaffected by mud or other foreign objects in the water.

See: Report of the Commissioner of Patents for the Year 1851, Part I, Arts and Manufactures, (Washington, 1852), p. 64; Official Descriptive and Illustrated Catalogue; Great Exhibition of the Works and Industries of all Nations, (London, 1851), pp. 1441; "Gwynne's Centrifugal Pumps," The People's Journal, 1 (February, 1854):102-3; Combined Directories of Jersey City, Hoboken and Hudson. (Jersey City, 1854), between pages 20 and 21. Photographs 15-23 show the wheel house and the machinery.

4. "Adirondack Iron and Steel Company," (1854), p. 21. The dam was only 700 feet long.

5. Frederick Overman, The Manufacture of Iron in All its Various Branches, (Philadelphia, 1850), p. 151-2.

6. The Making, Shaping and Treating of Steel, (Pittsburgh, 1971), p. 9; Richard Schallenberg and David Ault, "Raw Materials Supply and Technological Change in the American Charcoal Iron Industry," Technology & Culture, 18(July, 1977):465.

7. Schallenberg and Ault, pp. 436-66.

8. The Making, Shaping and Treating of Steel, pp. 9-10;

Overman, (1850), pp. 156-8. The Lonaconing Furnace in Maryland, the first U.S. coke furnace, used iron binders. See Katherine Harbey, "The Lonaconing Journals," Transactions of the American Philosophical Scoiety, 67(Part 2, 1977):19. See photographs 24-26 for views of the binders.

9. See HAER drawings by Barry Richards and John Bowie for illustrations of all the features discussed here and below.

10. Overman, (1850), pp. 151-2.

11. Agreement with Hickok and Mear's, Machinists, Fort Edward, N.Y., 15 August, 1850, McIntyre Correspondence, THS; Overman, (1850), p. 398.

12. Overman, (1850), p. 400.

13. Overman, (1850), p. 442.

14. John Percy, Metallurgy, (London, 1864), pp. 400-3; J. R. Johnson, Blast Furnace Construction in America, (N.Y., 1917), p. 191-2.

15. Inventory of McIntyre's Estate, MS 65-28, Box 5, Folder 7.

16. David Mushet, Papers on Iron and Steel, (London, 1840), pp. 252-4, Plates II and VI; Overman, (1850), pp. 156-171, 412-4.

17. James Hodge, "Iron Ores and Iron Manufacture of the U.S., New York," American Railway Journal, 22(1849):559-7, 591-5, 607-9; Elmer Barker, The Story of Crown Point Iron, p. 8, T. F. Witherbee, :The Manufacture of Bessemer Pig-Metal at the Fletcherville Charcoal Furnace, Near Mineville, Essex County, New York," Transactions of the American Institute of Mining Engineers, 2: (1873-74):65.

18. See HAER photographs of the stack and machinery, especially #5, 14, 21, 24, 26, and 27; also see HAER drawings.

# CHAPTER XI

This, then, was the furnace that the partnership of Stanton and Wilcox assumed control of in August, 1854. The original owners' strategy of completing the stack to entice a sale appeared to have worked. On August 24, 1854, the "New" furnace went into blast for the first time.[1] An impressive spectacle must have marked the operation at that time. Today, a heavy forest covers the site, but in 1854, the entire stretch of land toward the village and beyond, lay cleared of timber. As the HAER photographs depict, the stack and covered charging bridge dominated the scene. But the fascinating center of mechanical activity must have been the wheelhouse. In these tight quarters, with the creaking of the water wheels, the splashing of the water, the hissing of the air as the cylinders pushed the air toward the furnace, and the whirring of the pump and ore stamp line shafts, centered the power that enabled the furnace to run. Working there may have been dangerous, when it came time to adjust the stroke of the piston on the blowers especially,[2] for there was little room to move.

But certainly the conditions in the wheelhouse were more comfortable than those enjoyed by workers at the furnace. While the mechanical heart of the operation was located in the wheelhouse, the furnace captured the attention. When in operation, a pall of smoke and dust move have lain over the valley. At night, the orange glow of the fire lit the sky. For the workers, the overriding sensation had to be one of heat. Even when the winter temperatures plunged to not uncommon lows of -25° and -30°, the heat remained. And when summer brought both heat and humidity, and black flies, and mosquitos, the work must have seemed unbearable.

The actual process of making iron at the "New" furnace did not differ at all from the means used at the earlier smelter in the village. The materials were prepared in much the same manner and stored in the warehouses near the top of the hill above the stack. Charcoal, burned in brick kilns at the village, and iron ore, from the various outcrops in the vicinity, were the key constituents. A wooden trestle, called the charging bridge, connected the hilltop with the top of the furnace. The bridge was completely enclosed, and housed the ore stamps that crushed the ore to the size of small pebbles. The topmen were given the hot task of weighing and feeding the raw materials into a small hatch in the brick chimney that covered the tunnelhead, or charging hole. This charge would slowly work its way through the furnace, while the increasing heat and the presence of carbon monoxide reduced the iron from the ore. The blast of air blown into the furnace enabled this combustion process to occur. The blowing machinery in the wheelhouse provided the blast, as a water wheel drove a set of blowers that pumped the air through a hot blast stove before it entered the furnace through three tuyeres, or nozzles. It was in the immediate vicinity of these tuyeres that the iron actually became molten. About every 12 hours, a puddle of molten metal had formed behind the dam stone of the hearth, and was ready to be tapped. The furnace master and his helpers prepared a through in the sand floor of the cast house, which led into a set of molds, called pigs. They unblocked the tap hole in the dam stone and let the molten iron course into the molds. After cooling, the helpers dug the pigs out of the sand, and prepared them for shipping south, or for refining at a chafery forge, which turned the cast iron into wrought iron.

The work was hot and involved much heavy carrying. It was also dangerous, for the slightest contact of the molten metal with water could cause the metal to explode and shower all of the workers with hot, burning iron. And as mentioned in earlier chapters, this was skillful work that demanded the constant attention of the master and his crew, as they dealt with the constantly changing demands of the furnace. The mix of the materials, the temperature of the blast, and the volume of the blast offered ample room for experimentation in the quest to produce as much iron as possible from as little ore and charcoal as possible.

The efforts of the workers at Adirondac resembled that at any ante-bellum iron works. Yet as has so often been the case, the identity of the men who made this whole operation feasible has been lost or obscured. Especially in the case of this furnace, where the owners of the company had no experience in the manufacture of iron, the contribution of the workers deserves re-emphasis. Unfortunately, the available record offer little enlightenment on this score. We know next to nothing about their life and leisure, where they were from, their length of tenure, or even accurate accounts of their accomplishments. But these men made the place go.

There were not as many workers in 1854 as during the 1840s when over 100 people lived in the massive boarding house and 16 double dwelling units at the village. Stanton adn Wilcox seem only to have used the raw materials on hand - 250,000 bushels of charcoal and 3,000 tons of ore - and not to have hired hands to prepare more.[3]

The key question was whether the "New" furnace solved any of the problems that had bedeviled Porteous's efforts to make iron. There are no clear indications to answer this query, because the new owners seem not to have corresponded with McIntyre and the original partners. All that can be determined was that the furnace did produce iron. Henry Jarvis Raymond, editor of the <u>New-York Daily Times</u> published an account of his visit to the works in late May and early June, 1855, that proved this point. Raymond was a member of an entourage of New York's prominent business leaders that travelled the route of the Sacket's Harbor and Saratoga Railroad as guests of the railroad company. (The railroad still floundered, and was trying to gain financial support). Raymond made a 3-day side trip into the works, where the furnace was then in blast and he described the scene.

> On our way to the boats, we looked in at the new furnace, which was built last summer, by the new company, at a cost of over $43,000, and which is now the only one kept in operation. As it was very

> nearly time for the morning run, we waited to see how pig-iron is made. A long row of moulds in sand had been prepared - lying like the cross sleepers on a railroad track, some three long, and eighteen or twenty inches apart, and connected by a channel running along the side. When everything was ready, the furnace was tapped, and the melted iron flowed out in a bright red stream, filling the moulds and depositing about six tons of the most beautiful pig iron I ever saw. Breaking one of them after it was cooled, it presented a surface white as silver, and entirely free from flaws and impurities of any kind. ...This furnace makes two of these runs daily, producing from ten to twelve tons of iron; and this is, at present the extent of the iron works at Adirondack. Nothing but capital, and a good road giving them easy access to market, is needed to enable the Company to produce ten or twenty times as much - every ton of which could be sold at remunerative rates.[4]

Raymond as an amateur saw no difficulties in the operation of the furnace. Certainly, he did not mention shoveling the cinder and slag out of the furnace, as David Adams had complained of in 1844, or as Hodge had observed in 1848 at the first furnace. Arguments from the absence of information invariably are risky, but in this case, it appeared that the new furnace did operate more smoothly. Two later observers have corroborated this opinion. One was A. J. Rossi, on his 1892 visit to the desserted works. He found that the stack was clear, with a glaze over the whole lining. A quantity of salamander or debris was left on the hearth as at any furnace. But he found no indication of hard working.[5] Rossi had a goal in mind, of course; to dispel the prejudice against the use of titaniferous ores. The new furnace's condition, Rossi argued was a clear indication that such ores could be worked. As was written in an article in The Iron Age 16 years later,

> A highly interesting corroboration of the fact that the use of titaniferous ores in the blast furnace does not necessarily mean endless stoppages through the accumulation of impossible masses is furnished by the condition of the old furnaces at Tahawas...To the modern furnaceman, who knows that the furnace carried a burden of highly titaniferous ores and concentrates, the condition of the interior of the furnace is its most interesting feature.[6]

Rossi's September, 1892 visit to the village was only the opening salvo in a 20-year campaign to revive the prospects of opening a mine at Tahawus, (See below, Chapter 12). Those efforts produced some supporting data to confirm Rossi's opinion. F. E. Bachman was a noted furnace manager involved in tests of the McIntyre ores. He also visited the "New" furnace, and wrote

> The observations which I have made of the remains of the old McIntyre Iron Company's furnace, near Tahawas (sic), N.Y., have almost convinced me that ore mixtures containing as much as 20 per cent titanic acid can be furnaced, as that bosh of this furnace has every indication that it was never scaffolded, and the hearth is as free from salamander as any furnace I have ever seen, while the dump shows no indications of what we would call to-day 'hard-luck furnacing, such as heavy runners, salamanders, black cinder and scrap. Unfortunately, there is no record of this...furnace in existence.[7]

Other tests successfully smelted the ores in blast furnaces, without repetition of the type of problem Hodge had reported. In his summary of furnace tests at Port Henry in 1913, Bachman reported that, "The slags produced will be of much greater fluidity than those produced when $TiO_2$ is not present."[8] This observation directly contradicted the conditions encountered at the 1844 furnace. Whether these later tests matched the operating results attained during 1854 is another unknown. But Rossi analyzed the slags he found at Adirondac, and they showed as iron oxide over 25%.[9] These figures indicated that the iron ran more smoothly and was thus successfully reduced in the furnace. A higher iron content in the slag would have indicated a continuation of difficulties in producing a molten slag.

Unfortunately, the actual financial condition of the new partnership did not match the greater success of the smelting facility. By January, 1855, McIntyre and Robertson were still awaiting the first installment payment from Stanton and Wilcox. McIntyre and his partners refused to accept bonds of the Sacket's Harbor and Saratoga Railroad in exchange. Apparently Stanton & Wilcox were involved with the railroad venture, but the owners correctly perceived that the railroad had a very shaky future. As a result, McIntyre and Robertson found themselves forced to reassert control of the property. James McIntyre, Archibald's son, had urged this course early in January, saying that, "They are using your coal, iron, etc., that you have produced at great expense and drawing against the iron produced to meet their expenses. Indeed, the iron produced appears to be their sole dependence for sustaining the works at present." Moreover, James dismissed the offer for railroad bonds from General Lyman, listed on the 1854 prospectus with Butler as a director, as silly. As James wrote to his father, "Mr. Robertson's opinion, in which I fully coincide is, that these bonds cannot now be considered as much more real value than S. & W.'s paper, and that it would be utter folly to allow them to go on without better security than we understand them to offer."[10]

They chose to follow Jame's advice, and by January 13, James and Robertson had departed for Adirondac to take over. A proposal dated January 18, 1855, may have been the guide to their actions. Until Stanton and Wilcox paid the balance of the first installment, plus $4,303.37 for machinery and $6,220.09

for expenses from July 27, 1853 to August 1, 1854, McIntyre and others were to run the furnace. The extended deadline for payment was March 15, 1855.[11] But the buyers apparently never made the necessary payment.

James McIntyre arrived at the works in early February and immediately reasserted his father's and partner's control. He described what he found at Adirondac in this way.

> I can give you but little information. Mr. Curtis will continue for us - The company owe about here some $3000, - of which $1800 is due to labours. We are to talk over what shall be done in this matter this evening. There is altogether about 130 tons of iron now made - 25 tons are at Crown Point and Curtis thinks Butler has about 20 tons at Pottersville and on the road. Curtis has stopped the men drawing for Butler and has sent a team out to pick up the iron on the way and deliver it at Glens Falls. The rest will probably go to the lake...[12]

The money owed the workers at the furnace proved to be James's first major stumbling block. They demanded their back pay, and on the 7th, they struck for two hours to force their demands. The firemen and topmen stayed off the job for two hours before agreeing to a formula whereby they received 50% immediately, and the remainder of their back wages on July 1st. James felt blackmailed, adding, "...galling as it was to do it," but if the furnace had not been tended for 4 hours, he would have had to end the blast. Curtis did manage to trim the work force by five or six workers, paying them 75% of their claim.[13]

James did report that "The furnace is working well and Curtis seems well satisfied." And within six weeks, James, having returned to Albany, had heard from Curtis that the furnace ran 2¼ tons per casting, with three such each day.[14] Unfortunately, an accurate assessment of the new furnace just cannot be made, because of the sketchiness of detail. James's comment about three casts a day contradicted Henry Jarvis Raymond's observation of early June. Their daily production figures also differed. Nor can it be ascertained how long the furnace remained in blast. McIntyre's 130 tons of iron could not have represented the total production for Stanton and Wilcox. Even at six tons a day, that would have represented only three weeks production, and certainly the "New" furnace had worked longer than that. In 1867, William George Neilson compiled a set of statistics on New York blast furnaces for the American and Steel Association. He noted that the second Adirondac furnace "...made two blasts of about six months each, probably in the years 1855 and 1856; about 1200 tons were made at each blast."[15] But as Neilson noted, all his figures were estimates.

The questions of whether the furnace actually made two campaigns, has remained. There would have been enough raw material on hand for a full year of work, based on the 1854 figures in the prospectus. Neilson seemed sure that the furnace ran twice - he estimated only the production. And James R. Thompson wrote in 1881 that the furnace had run for two years. But Thompson made a number of errors in that account, such as giving the construction date as 1846, the height as 54 feet, rather than 45 feet, and production at 10 to 12 tons of metal daily.[16]

Thompson's errors no doubt stemmed from the passage of 25 years. But other hints in the correspondence raised doubts about the supposed two-year operation of the furnace. Primarily, the intentions of the owners must be considered. James set the tone in this regard. In January, 1855, McIntyre's son had argued that if they did have to again run the furnace, they should do so only as long as the stock of charcoal and iron on hand lasted. Then, he suggested that they "...blow out and wait for offers from other purchasers, reducing the establishment to a mere farm in the meantime. I cannot but think that before a year rolls over our heads we will have as good or better offers from parties of more solidity than the present."[17] How much like Henderson, Robertson, and his father James sounded! He echoed their sentiments, voiced so constantly since 1850. Clearly, the owners had no plan to actively make iron. James merely planned to take advantage of the fact that others had started the furnace. Using up the materials already on hand offered a chance to recoup some of the costs of preparing them, as well as a means of paying for $3,000 debt left behind by Stanton and Wilcox. Given the attitude so prevalent among the owners, there seems to have been little chance that had the furnace been blown out they would have put it back into blast again.

Neilson was almost certainly correct, though, about the furnace running for two separate campaigns. Stanton and Wilcox may have run the furnace from late August until December, and restarted it in January just before James arrived, thus explaining why only 130 tons of iron were on hand. But a comment made by James in March confused the issue. While noting that Curtis hoped to get three 2¼ casts a day from the furnace, he said that this output would be reached "when she gets to her full burden." This statement suggested that Curtis was just getting the furnace into blast again, indicating that the owners had indeed carried on the works with more vigor than their comments indicated. However, it happened, the furnace must have been stopped briefly at some time early in 1855 in order to account for Curtis's continued operations at least through June, 1855. The furnace could not have operated continuously from August 24, 1854 to June 4, 1855, when Henry Jarvis Raymond observed the production of pig iron, without stoppage for repairs.[18]

Raymond was probably very fortunate, however, to have seen iron produced at Adirondac. Certainly his was the last account of operations at the village. Almost certainly, Curtis received instructions to blow out the furnace sometime later in 1855, and the owners fell back on James's plan of maintaining the property solely as a farm. Certainly expenses for 1856 showed no shipment of supplies to Adirondac that year. The owners had expended only $436.60 that year, with $100 going as payment for shipments of pork and flour in 1854, and $317.65 earmarked for the Essex County taxes in 1855. Moreover, James R. Thompson visited the village in late September, 1856 and made no mention whatever about iron production. James McIntyre wrote to his father that Thompson, "says Adirondac looks deserted and gloomy enough, but that the crops were looking well." The most telling comment, however, was James's decision to push for approval of a plan to cut lumber on the property that winter. "Without some of this kind the men and teams would have nothing to do this winter, and as you are aware, we cannot reduce our force, for the reason that a single family cannot be induced to remain alone."[19] Quite obviously, iron-making had ceased by the time James wrote that letter, probably a full year earlier. Neilson must have made an error in guessing that the second campaign occurred in 1856, otherwise the men still at the works would certainly have had plenty to do. By September, 1856, there apparently was no iron left to ship out that winter. The short life of the "New" Furnace, then, must have ended in 1855.

The owners reverted to the plan James described in early 1855, one that embodied their whole outlook after 1851. Robert Hunter, a brickmaker, was hired for a dollar a day to stay with his family at the village. He had use of the farm and livestock, but iron making did not figure in the plans. Hunter's family stayed on as the only inhabitants until about 1872 when Mrs. Hunter died. Hunter then left, having buried his wife, Sarah, in the town cementary, where her headstone still marked her resting place in 1978.[20] The only venture that continued involved lumbering. Henderson's son, another Archibald, wanted to cut 4,000 to 5,000 spruce logs in the winter of 1856-57. James approved of the plan, arguing:

> If he does this work he will employ the men and teams and thus make a market for your hay and grain. The spruce timber in that vicinity is not likely to improve and I do not suppose the cutting off of a few thousand logs would at all affect the value of the property as a whole, while the money you would receive for the logs, hay, grain, etc. would keep up the place for sometime without any expense to the proprietors.[21]

The works quickly assumed the appearance that won for it the name "The Deserted Village". In fact, when a freshet in October, 1857, washed out the dam at the Lower Works, carrying away the sawmill, Robertson had to send Henderson's son up to Tahawus to determine the true extent of the damage. Thompson instructed Hunter, the only inhabitant in the vicinity, to saw what he could, but no one else remained to advise the partners what they could do about the damage.[22]

Despite the completely unsatisfactory end to the operations at the furnace, the goal, as always, remained to sell the property. But in this endeavor, the partners showed only a little more vigor than they had in actually producing iron after 1850.

James's sanguine expectations of an early sale, expressed in January, 1855, did not hold true. Not until late 1857 did serious prospects for a sale again appear. J. R. Thompson played the major role as negotiator in this offer. A group of English investors showed an honest desire to purchase the works. The Sacket's Harbor and Saratoga Railroad arranged for a gentleman named Hamilton to represent their company for sales purposes in England.

Hamilton talked to Thompson, for this salesman believed that ownership of the iron works by the railroad could enhance the sales prospects of both. Hamilton wanted to have the right of first refusal over any sale of the iron company until July 1st, in order to attempt to sell both properties in tandem. Thompson agreed and Hamilton departed for England as early as March, 1857.[23]

Hamilton eventually met with greater success than the iron company alone had ever achieved in England. By the end of September, Hamilton had convinced two financial houses to accept $1 million worth of railroad bonds, "on condition that the agents whom they should send out here for the purpose, should report that the Rail Road property, including Adirondac, was as was represented." One of the agents was Sir Charles Fox, architect of the Hyde Park Crystal Palace in 1851. But the inspection party was greatly delayed. Due early in October, they still had not reached America by early November. Not until January, 1858, did Fox arrive in New York, only to be called back to England before he could visit the iron works. Thompson explained, "Before leaving, Fox gave assurances that some person in his stead would soon be commissioned to make the investigation, and everything he said on the subject was calculated to show that they were earnest about desiring to make the purchase."[24]

But 1857 proved to be an unpropitious time for arranging the sale of an iron works, due to the business distress in this country. By October, Robertson felt all chances of the sale were ended by the panic, but Thompson later reassured them, repeating the Englishmen's statements that the negotiators would not be disturbed by the unsettled economic conditions. Yet the economic conditions must have influenced the intentions of the English investors, for not until July 13, 1858, could Thompson report, "I start for Adirondac tonight to meet the English Commissioners there on Thursday or Friday, the prospects of a sale now look very encouraging." And Thompson's optimism seemed justified, as he wrote describing the inspection visit.

> ...they examined the works, and ore beds, very carefully and seemingly with much interest. We went to all the beds except the Cheney...At present there seem to be no doubt but they will make a very favorable report, both of Adirondac and the Rail Road advantages...[25]

Unfortunately, subsequent events proved that once again the owner's hopes had come to naught. Hamilton returned to England after the inspectors had toured the properties. Through September and October, the railroad's salesman could report only delays. By November, he finally seemed on the edge of success. Robertson's son wrote to James McIntyre,"Jimmie (Thompson) says the prospects for the sale of Adirondac are very flattering, and he thinks without a doubt; all the parties have agreed to it by letter, and all with the exception of one who is on the continent, have signed the papers. Hamilton will be in the next steamer which is due in a few days."[26]

But Hamilton did not return on the next steamer. As late as January 22, 1859, the salesman still pushed their hopes in London. Somewhere along the line, Hamilton found himself stymied, and unable to complete the sale. As late as November 14, 1859, nothing had occurred, although a new sales agent had written to Thompson, "which gives us still additional reason to hope that before long the Adirondac property will rejoice in new owners."[27] The reason for the delay was another of the unknowns that confronted the historian of the iron works. The problem may have arisen in the United States because in 1858 both Archibald McIntyre and Archibald Robertson died. The increasing infirmity of the patriarch of the ironworks made his death expected, but Robertson's came unexpectedly. The loss of the two owners threw the financial affairs of the company into chaos. The confusion stemmed primarily from McIntyre's will, which put all his property into trusts for his children. That move meant that the trustees of the estate actually received a greater annual remuneration than the heirs. A suit brought by the two sons to set aside the will led to a family fued. This quarrel had a larger implication, for it prevented concerted action on a confusing point of ownership. It turned out that Younglove, the attorney, had belatedly filed the deed conveying the property to Butler, signed in 1854, at the Essex County Court House sometime in 1856 or 1857. It took a lawsuit by the company to determine that 1854's attempted sale, apparently handled by the owners as individuals and not as representatives of the company, had not abrogated the existence of the firm. But until that question was resolved, uncertainty existed to prevent a sure sale. And the acrimony engendered by McIntyre's will lengthened the resolution of that ownership question, for McIntyre's daughter and her husband refused to talk to James and his brother.[28]

Whether this legal matter was alone responsible or not, the anticipated sale did not go through. Nor did another possibility that had appeared in 1857, during the English negotiations. Stanton, it seemed, wished to have a second chance at ownership. Stanton had made a fortune selling Latin American railroad stock in London. If the Sacket's Harbor and Saratoga Railroad deal fell through, Stanton wanted the chance to purchase the works. He calimed to have sufficient resources to run it. Robertson at the time belittled the offer, saying, "I have not much faith in Stanton, but am glad at even such an additional prospect of making a sale."[29] But like the proposed English sale, so near to being closed, Stanton's offer did not materialize.

By 1860, the entire compexion of the iron works had changed. The tone set in 1851 had predominated, leading to the virtual abandonment of the village after 1855. The "New" furnace, outwardly the high point of the company, actually ended up as a fitting headstone to 25 years of dreams and hard work. The goal of disposing of the property to men able to meet the necessary financial outlays was never met, despite two chances in the 1850s. By 1860, the Adirondack Iron and Steel Company was dead.

The firm's failure stemmed from several easily identifiable problems. First and foremost stood the immense transportation headaches, and every commentator from Lossing and Dornburgh to Masten and Hochschild have emphasized this cause for failure. Without doubt, the inability to move either into, or iron or the ore out of the works doomed the plans to turn Adirondac into another Mythr Tydvil. Neilson's 1867 comment was typical. "The cause of abandonment of the manufacture of iron here was the difficulty of transportation. It had to be hauled in wagons 48 miles to Lake Champlain."[30]

Other factors that led to the abandonment of the company's effort included the technical difficulties of actually working the ore, which, if they did not actually defeat the owners, at least delayed the chances of success for so long that by the time the "New" furnace went into blast, the patience, determination, enthusiasm, and fortunes of the original partners had been exhausted. The deaths of the proprietors came at crucial times in the company's development; Henderson's when his expertise was so important, and McIntyre and Robertson at a time when solidarity and a firm outlook were required to carry through the sales plan. Along with their deaths stood the lack of any heir with sufficient knowledge, ability, or willingness to push on with the challenge of either making iron, or closing a sale. James R. Thompson provided the only guidance, for James McIntyre proved to be largely ineffectual. The lack of any one firm hand controlling the company's efforts generally reflected the sharp shift in outlook that emerged in the years after Henderson's death. The shift from optimistic enthusiasm to pessimism in the future was made manifest by the company's unwillingness to expend any more money or effort on the property after 1851, and the greater push for a sale.

The shift in attitudes deserves greater emphasis than it might otherwise receive. From a businessman's point of view, the retrenchment of the 1850s made perfect sense. Any rational assessmen of the prospects for recovering their investment would have dictated a screeching halt to further expenditures, precisely because of the transportation and technical difficulties. But those difficulties had always stared the owners in the face. Yet before they finally gave up, they expended about $500,000 on their dream to make iron at Adirondac. The most indicative points on this score were the repeated efforts and expansion plans, which carried the owners past several logical stopping points. Had the owners been guided solely by rational economic analysis, the firm should have halted its efforts well before it did. But the owners did not stop. The primary goal which the owners voiced was to make iron, not money. The money would follow if they were successful, but the main motivation for their efforts was the challenge of making their ores yield iron. Moreover, personal goals edged them on at Adirondac. McIntyre had the North Elba failure to redeem; Henderson saw the chance to repeat the story of his pottery. Moreover, they knew they could succeed, for their optimism so readily overcame the moments when despair and failure confronted them. Their confidence had appeared from the very start with the belief that their iron was special. It appeared in the whole venture into crucible steel manufacturing, and McIntyre's insistence on producing only a quality product.

Thus the early years of the Adirondack Iron and Steel Company presented a graphic representation of how far a company could be carried by the enthusiasm of the promoters. The very first years of operation had shown the magnitude of the problems, but efforts had still resumed in 1838, despite the absence of any concrete evidence that they could solve the transportation problems still confronting them. The next 12 years had continued the attempt, with few if any outright successes. Yet only in 1851 did the tide permanently turn from optimism to despair. But even then, in the midst of the austerity program that followed, the partners expended $43,000 on their last addition. Rossi had reasoned that his continuation with the larger furnace indicated the successful smelting of titaniferous ores. "Had the working of the small furnace first put up been subject to insurmountable troubles from accretions of titanium deposits, it would not have been remodeled, and still less would a larger furnace have been erected..."[31] Yet the record clearly showed the the "New" furnace went up despite the failure of the 1844 furnace to work easily. Only a hefty measure of enthusiasm and belief in their ability to succeed can account for the continual efforts of the Adirondack Iron and Steel company to produce iron at the village.

Explanations for the optimism that flew squarely in the face of reality must come from the more general attitudes and outlook of 19th century America. McIntyre and Henderson lived during the time when the United States's westward expansion moved into high-gear, and when Manifest Destiny became an accepted belief. This expansive mission was both buyoyed by, and the cause of the ambition that Alexis de Tocqueville commented upon during his American tour as such a pervasive feature of American society.[32] Confidence and exuberance stood out as the common place attitudes of the American people.

Technology played a key role in the pursuit of the expansive mission embraced by most Americans, for technology offered the solutions to the problems that confronted the United States. Railroads and steamboats had conquered the vast distances of the country, while plows and reapers tamed those vast plains. Here, then, was the tradition within which Henderson operated. Daniel Boorstin had noted his characteristic in identifying "boosters" and "gogetters" as accomplishing so much in this country. The experience at Adirondac was repeated constantly during the 19th and 20th centuries in the United States, as gambling businessmen took enormous risks without reasonable expectations of success. This persistance stands out as one of the themes of American business history. And the usual explanation is cast in purely economic terms - the desire to grow wealthy. Continuation of obviously doomed failures represent only last-ditch efforts to recover the investment. But as the Adirondack Iron and Steel Company example indicated, another factor can be included. The continued expansion at Adirondac can be dismissed simply as bad judgement. But the reason for this bad judgement lay in the enthusiasm of the partners for their project and property that led them to further efforts. The tone of the letters clearly demonstrated that other factors besides the desire for wealth or the recovery of the investment goaded these men on.

David Henderson most clearly embodied these non-economic goals. Henderson knew what technology had already accomplished; he had seen the results of the Industrial Revolution in England. So his optimism seemed well founded, for his scientific researches and those of men like Walter Johnson and James Booth could not help but produce an answer to their problems. Henderson's outlook merely matched that of so many other industrial and manufacturing entrepreneurs, who saw chances to exploit nature and advance civilization and American culture. Coincidentally, they became wealthy. These men were risk takers, but not the type who weighted the odds. They took their chances, sure that technology would back them up and enhance their chances. Most of all, their enthusiasm and love of the challenge carried them on. Henderson and McIntyre occasionally wrote in their letters in terms that showed their awareness of the economic unrealities of their venture. But they always ignored their economic analyses, and made yet another attempt to produce iron at Adirondac. Enthusiasm must account for those continuations of effort.

Boorstin and others write about the western United States and the frontier in such terms. But the Adirondack region was a frontier as well, and in much the same way as the West, northern New York attracted more than its share of wild schemes. The goal was to open the region to the world, richly rewarding the promoters. But personal enrichment alone cannot explain the continual emergence of plans of the most visionary character. The Adirondack Iron and Steel Works was far from being the only example of enthusiastic boosterism. Transportation schemes, as noted at the start of this paper, were legion in this part of the world. Emmons mentioned three different options for opening the works in his 1840 pamphlet boosting the prospects of the iron works. One was McIntyre's plan of a canal up the Hudson River to the works, the practicability of which a state engineer's report confirmed in 1839. A second scheme called for the improvement of Schroon Lake and River to the Hudson, and of the Hudson to the Champlain Canal. A railroad provided the link between the end of water navigation at Schroon and Adirondac. A third arrangement foresaw a company, which was actually granted a charter, building a route between Little Falls on the Erie Canal to the St. Lawrence, via canal to Long Lake and slack water navigation and railroad the remainder of the way. A branch canal tied Long Lake to Rich Lake from where the Hudson River would carry traffic into Adirondac.[33]

Such schemes carried over into the railroad era, as the Saratoga and Sacket's Harbor Railroad demonstrated. Some 40 miles of the route were actually graded, after several engineering plans of the route had been worked out. William C. H. Waddell served as one of the prime boosters of the railroad. He published a laudatory account of the benefits offered by this route in a paper read before the American Geographical and Statistical Society in 1854. But while he favored the rail line, Waddell also presented two complex slack water navigation schemes intended to link the eastern and western ends of the region. Both schemes called for connecting the long group of lakes that stretched from east to west - the Saranacs, Long Lake, Forked Lake, Raquette Lake, The Fulton Chain, and the Moose River - so that steamboats might traverse the whole area, almost to Lake Ontario. The plans Waddell presented had even been elaborately costed out, so that Porfessor F. N. Benedict figured the whole improvement would cost $292,950, or $2,483 per mile.[34] Significantly, Benedict's system reached neither Lake Champlain nor Lake Ontario. It thus offered no link to the outside world itself. Like every other transportation plan proposed for the region, little if any consideration was given to where the revenue, freight, or passengers would come from. Instead, Benedict was enamoured with the mere thought of building the route. The surety of future economic development provided the only economic rationale required.

The Sacket's Harbor and Saratoga Railroad was not the only railroad proposed for this part of the world. As Harold Hochschild has written,

> If all the railroads proposed to cross northern New York by way of Blue Mountain Lake, Raquette Lake, Forked Lake and Long Lake had come into being and remained in daily operation, half a million trains would by now have rumbled past these tranquil Adirondack waters. The planning of the railroads began in the fourth decade of the nineteenth century and continued into the first of the twentieth. None was built.[35]

There were some intriguing schemes, like the railroad and steamboat arrangement that ran from Raquette Lake to Blue Mountain Lake, via Eagle and Utowana Lakes. That railroad linked steamboats on the last two lakes over a one mile neck of land, and was the shortest chartered line in the country. Another line built was William Durant's Adirondack Railroad from Saratoga to North Creek on the Hudson.[36]

The railroads had no corner on visionary schemes. A Mr. Pearson, the brother-in-law of Professor Benedict, proposed an arrangement to harvest timber on the iron company's property. Knowing the area between Rich Lake and Long Lake, west of Adirondac, Pearson wanted to move timber down the Cold River to Long Lake on a point opposite Round Pond. He considered building an overland system to move the logs into Lake Catlin and Rich Lake, and thus into the Hudson River. He figured for $10,000 they could move timber from the St. Lawrence to the Hudson River watershed, at a cost of $.50 to .60 a log.[37]

Alexander Ralph developed a lumbering scheme of his own shortly thereafter by joining with Robert Clarke and Henry Dornburgh to purchase a saw mill at Potsdam on the Raquette River. The mill, with a 9-foot head, and three gang saws used a rose wheel for power. Ralph called it a great bargain, observing that, "Lumber business on that river is just commensing and must now take the place of the Hudson River for lumber, as the pine on it is now all cleared off with the exception of a few small lots." The desire to make it drove Ralph to cut timber on the company's property at the Cold River, without permission.[38] But such deliberate trespassing marked more than one lumbering operation. The other point in Ralph's dream was the surety of his success; Potsdam he proclaimed, was "destined to be a second Glens Falls,"[39] a town already noted as the center of Adirondack lumbering. This certainty marked Henderson's outlook as well, and more than anything else explained not only continued efforts at Adirondac, but its very existence as well. The Adirondack Iron and Steel Company never made economic sense, as a rational businessman would calculate it. Only when the enthusiastic boosterism and unbounded confidence of the proprietors are considered can the rationale for this venture be viewed in perspective.

Notes

1. "Adirondack Iron and Steel Company," (New York, 1854), p. 41.

2. This adjustment was managed by the cranks, which had a sliding connection for the connecting rod. Initially, the company had specified cranks with a counterweight, but these pieces offered no way to adjust the stroke. So the cranks still on the shafts replaced the original pieces. Discarded, the old units still lay in a corner of the cramped wheelhouse. See HAER drawings for the layout of the wheelhouse.

3. Adirondack Iron and Steel Company, (N. Y., 1854), pp. 41-2; James McIntyre to Archibald McIntyre, 11 January, 1855, MS 65-28, Box 5, Folder 19b.

4. Henry Jarvis Raymond, Letter to the New York Daily Times, 7 July, 1855; in Harold Hochschild, "Addendum to Chapter 13," Township 34, (Syracuse, 1953), p. 170N. Photographs 27 and 28 show the hearth area where the iron was tapped; 29 and 30 show the tuypre arch, minus the blast pipe.

5. Auguste J. Rossi, "Titaniferous Ores in the Blast Furnace," Transactions of the American Institute of Mining Engineers, 21: (1892-92):845-6. The furnace remained this way in 1978.

6. "A Great Adirondack Iron Ore Deposit," The Iron Age, 84(14 October, 1909): 1148.

7. Ibid.

8. Frank E. Bachman, "The Use of Titaniferous Ores in the Blast Furnace," American Iron and Steel Institute, October Meeting, 1915(?), pp. 399-400.

9. A.J. Rossi, "Titaniferous Ores in the Blast Furnaces," p. 846; see AlJ. Rossi, "Titaniferous Ores in the Blast Furnaces," The Iron Age, 51(2 March, 1893):496. A later test gave an iron content in the slag of 6.94%. "A Great Adirondack Ore Deposit," p. 1148.

10. James McIntyre to Archibald McIntyre, 11 January, 1855, MS 65-28, Box 5, Folder 196; James McIntyre to Eliza McIntyre, 13 January, 1855, Box 4, Folder 7.

11. Sale to Henry and Harvey Wilcox, undated, McIntyre Correspondence, THS; Porposition to Stanton & Wilcox and Adirondac Iron and Steel, Co., 18 January, 1855, MS 65-28, Box 4, Misc. Papers.

12. James McIntyre to A-chibald McIntyre, 7 February, 1855, MS 65-28, Box 5, Folder 19.

13. Ibid., 8 February, 1855.

14. Ibid., 8 February, 1855; 20 March, 1855, Folder 19b.

15. William George Neilson, comp., The Charcoal Blast Furnaces, Rolling Mills, Forges, and Steel Works of New York in 1867, (1867), p. 246.

16. Adirondack Iron and Steel Company, (N.Y., 1954), p. 41; Neilson, (1867), pp. 244,246; James R. Thompson to George E. Hall in Cleveland, Ohio, 5 February, 1881, McIntyre Correspondence, Black Notebook, Volume II, p. 217, THS.

17. James McIntyre to Eliza McIntyre, 13 January, 1855, MS 65-28, Box 4, Folder 7.

18. James McIntyre to Archibald McIntyre, 7 February, 1855, MS 65-28, Folder 19; 20 March, 1855, Folder 19b; Henry Jarvis Raymond, in Hochschild, "Addendum to Chapter 13". pp. 170k-170m.

19. "Estate of Archibald Robertson in account with Estate of Archibald McIntyre, undated, MS 65-28, Box 2, (also copied in James McIntyre to Archibald McIntyre Robertson, 25 November, 1858, MS 65-28, Box 5, Folder 13); James McIntyre to Archibald McIntyre, 26 September, 1856, MS 65-28, Box 5, Folder 19b.

20. Thomas R. Kelso, "The Pioneers," Tahawus Cloudsplitter, XXIII(July-August, 1970):18; Benson J. Lossing, The Hudson, (Troy, 1866), p. 27; John Burroughs, Wake-Robin, (Boston, 1923), p. 97.

21. James McIntyre to Archibald McIntyre, 26 September, 1856, MS 65-28, Box 5, Folder 19b.

22. James R. Thompson to James McIntyre, 30 October, 1857, November, 1857, MS 65-28, Box 5, Folder 20; Archibald Robertson to James McIntyre, 31 October, 1857, Folder 13. Benson Lossing mistakenly placed the freshet in 1856, an error since perpetuated by Masten and Hochschild. Masten, (1968), p. 143; Lossing, (1866), p. 27; Harold Hochschild, The McIntyre Mine - From Failure to Fortune, (Blue Mountain Lake, N.Y., 1962), p. 11.

23. James R. Thompson to James McIntyre, 9 March, 1857, MS 65-28, Box 5, Folder 20.

24. Archibald Robertson to James McIntyre, 23 September, 1857, MS 65-28, Box 5, Folder 13; J.R. Thompson to James McIntyre, 1 October, 1857, Folder 10; 6 November, 1857, Folder 20; Archibald Robertson to James McIntyre, 21 December, 1857, 5 January, 1857, 30 January, 1858, Folder 13.

25. Archibald Robertson to James McIntyre, 10 October, 1857, MS 65-28, Box 5, Folder 13; James Thompson to James McIntyre, 6 November, 1857; 13 July, 1858; 23 July, 1858, Folder 20.

26. James R. Thompson to James McIntyre, 29 September, 1858, MS 65-28, Box 5, Folder 20; Archibald McIntyre Robertson to James McIntyre, 19 November, 1858, Folder 13.

27. James R. Thompson to James McIntyre, 22 November, 1858; 20 December, 1858; 22 January, 1859; 14 November, 1859, MS 65-28, Box 5, Folder 20.

28. James McIntyre to Caroline McNaughton, 25 May, 1858; 22 March, 1859, MS 65-28, Box 5, Folder 11; James McIntyre to James R. Thompson, 29 May, 1858, Folder 11; 21 May, 1859; Folder 20, J.R. Thompson to James McIntyre, 14 November, 1859, Folder 20; James McIntyre to James R. Thompson, 23 January, 1860, Box 2. A great deal of material related to the legal hassles of this question can be found in the Adirondack Museum's manuscript material. MS 65-28, Boxes 1 through 5.

29. Archibald Robertson to James McIntyre, 17 October; 14 November, 1857, MS 65-28, Box 5, Folder 13.

30. Neilson, (1867), p. 246.

31. A.J. Rossi, "Titaniferous Ores in the Blast Furnace," The Iron Age, 51(2 March, 1893):496.

32. Alexis de Tocqueville, Democracy in America, (New York, 1945), Volume II, pp. 256-62.

33. Emmons, "Papers and Documents," (1840), pp. 49-50.

34. Lossing, (1866), pp. 26-27; William C. H. Waddell, "Northern New York," A paper read before the American Geographical and Statistical Society, November 2, 1854, (New York, 1855), pp. 9-14, 42-48.

35. Harold Hochschild, Adirondack Railroads, Real and Phantom, (Blue Mountain Lake, N.Y., 1962), p. 1.

36. See Adirondack Museum exhibit on the first scheme; Richard Saunders Allen, "Better Late Than Never," Trains, January, 1959, pp. 42-5.

37. Archibald McIntyre to Archibald Robertson, (Draft on Robertson's of 8 June), 11 June, 1850, MS 65-28, Box 5, Folder 22.

38. Alexander Ralph to Archibald Robertson, 10 July, 1852; Ralph to Marion & Company, 10 July, 1852; Ralph Letterbook, MS 65-27, Box 40; James R. Thompson to James McIntyre, 20 December, 1858; James McIntyre to J. R. Thompson, 21 December, 1858, MS 65-28, Box 5, Folder 20.

39. Ralph to Robertson, 10 July, 1852, Ralph Letterbook, MS 65-27, Box 40.

# CHAPTER XII

The Adirondack Iron and Steel Company, although it continued to exist as a legal entity, had ceased to have any hopes of operating by 1860. As Thompson assessed things, "You know they never expect again to operate under their charter as a Company..."[1] Still, a flicker of life remained. Thompson himself orchestrated the small efforts that continued at Adirondack. Over the next 40 years, such activity consisted only of lumbering. For example, Ralph had a contract in 1865 to cut 8,000 standard logs, while in 1867, a party cut $3,000 worth of timber at $10 per spruce and $60 for pine.[2]

Thompson handled these matters for Judge Samuel Cheever, trustee for the McIntyre Estate. And he also continued to work on arrangements for the sale of the property. These arrangements were not frequent - Thompson was working on one in 1868, and even reached the point of proposing terms for another in 1875. Terms were set at an exchange of stock - $300,000 in bonds of the new company formed, interest free for one year. The company was to have a total capitalization of $2 million, with $1.7 million for the construction and equipment for a narrow-gauge railroad from Glens Falls to the works. The new company also hoped to build another furnace like the "New" furnace, and two others as well. They also figured to move 50,000 tons of ore annually to Troy or Albany. To be called the McIntyre Iron and Railroad Company, the success of this plan hinged on the sale of bonds of Europe.[3]

But like so many other ventures, this scheme came to naught. So did another effort in 1881, when a Gustavus Ricker in Washington expressed interest. Thompson in 1868 had felt the need to be realistic in light of optimism expressed by Judge Cheever about the sale talked of that year. Land values had not increased, he said, only the timber had any value.

> The mineral wealth of the property is without doubt very great, when the means of transporting it to market is provided, but the question arises, will anyone build a Rail Road to the mines without owning them? One thing is certain if the present Company do not become the purchasers of Adirondac - the road is as near the Mines as it ever will be under their Management, as I understand there is no longer an inducement to go even to Minerva, as that out bed is found to be more <u>fiction than fact</u>. I can assure you nothing would please me better than to see you get a full price for Adirondac, and I believe if the present parties do not purchase, it will remain unsold for a long time.[4]

Thompson proved to be correct in his assessment of the situation. But amazingly, there remained boosters who continued to predict renewed operations. Most of the published accounts in this line came from visitors to Adirondac. Just as during the years when the production of iron dominated the area, tourists continued to be attracted to the tiny hamlet in the woods, now a deserted village. Yet all expressed optimism, a fact that perhaps indicated how widely accepted the belief in the indominability of American progress was. Lossing, at Adirondac in 1859, later wrote in that vein:

> The workmen had all departed from Adirondack, and only Robert Hunter and his family, who had charge of the property, remained. The original proprietors were all dead, and the property, intrinsically valuable but immediately unproductive, was in the possession of the respective families. But the projected railway will yet be constructed, because it is needful for the development and use of that immense mineral and timber region, and again that forest village will be vivified, and the echoes of the deep breathings of its furnace will be heard in the neighboring mountains.[5]

Another account published in the <u>Plattsburgh Republican</u> about 1873 captured the same feeling.

> Nearly half a million dollars have, it is said, been sunk here by the Company, but yet it is a rich inheritance and will, in the not distant future yield to its owners and the State millions upon millions of money. Mr. Emmons, in his report had expressed his deliberate conviction that the whole valley of the upper Hudson is underlaid by this rich ore...The Adirondack railway is creeping toward this mine of wealth which is more valuable to the owners and the State than would be the richest gold mines of California, because however selfish the proprietors of an iron mine may be, they cannot, if they would develop their resources do so without spreading the blessings and comforts of remunerative employment among the laboring classes, through all the branches of iron manufacture from its first separation from the rock crudities at the forge fires, down to the most delicate and expensive products of the same useful metal. It is confidently expected that this road will touch at Tahawus, the Lower Works, and if it does, it is said that business will be resumed immediately at these rich mines.[8]

But the Adirondack Railroad, the reason for most of the hopes, did not proceed beyond North River - over 30 miles from Adirondac. Thompson had even guaranteed W. W. Durant, owner of that railroad, as well as builder of the Union Pacific, to deliver 300,000 tons of ore per annum on board cars at the mine, at a rate of $.70 per ton or less.[7] But Durant had reached the end of his resources, and completed the road only far enough to satisfy the state charter - 60 miles up the Hudson from Saratoga, or North River.[8] With that decision, the chances of a sale all but stopped.

By then, decay had set in, so that any new owner would have almost had to start over. The Plattsburgh Republican article described the scene in the mid-1870's.

> It is a strange feeling which one experiences as he comes suddenly, after days of tramping through the unbroken wilderness, upon this desolate hamlet.
>
> The machinery is still there, a large portion of it - the forges, trip hammers and blast furnaces; the water still pours over the iron dam, and the ore is yet unused, lying everywhere, thousands of tons to be had for the mere picking up. No need of any deep mining here with its attendant expense of hoisting and pumping. The forest of hard timber still stand, uncut, except those that covered the insignificant patches of cleared ground, around the village, and even these are being claimed by nature to their primitive condition so rapidly that very soon they will be clothed again with their native mantle of sturdy forest trees.
>
> Huge timbers which formerly supported out of door machinery and its massive appliances, stand leaning with their iron braces, threatening every moment to fall, coal pits of the approved pattern are falling into irretrievable ruin. Heavy trucks lie scattered about, the forges will soon be overgrown with vegetation, and the water-wheels converted into masses of rotten wood.
>
> You enter the shops and are startled at the strange echo of your footsteps which seem to threaten the intruder with disaster for distrubing their long repose.
>
> The wide and handsom street is covered with a thick mat of green turf, while the houses have a muffled, funeral air, as if that mournful funeral possession had just passed along. The little church still stands, but its back is bent with age, and it will soon fall beneath its own weight. The old bell which was wont to summon the workmen to their daily toil still hangs in the open air, upon the opposite site of the street from the boarding house, one end of the axle being supported by a gnarled maple tree, and the other by a rough post.

> One family is kept there by the Company and comfortable accommodations can be had there, being no lack of room in the house. Books too you see whose title at once arrest your attention as being of a much higher grade than you are wont to find so far from commercial and literary centers' and you are surprised to find upon opening them the label pasted upon the inside of the cover, 'ADIRONDACK LIBRARY".
>
> Nothing it would seem was forgotten by the managers which could contribute in any way to render their enterprise a perfect success and make their employees happy and content.
>
> But over the whole scene there reigns an air of solitude and desolation which the tourist is glad to leave behind.[9]

But while the story of the Adirondack Iron and Steel Company had reached an end, the saga of the property continued. In February, 1876, Thompson and some friends organized the Preston Ponds Club to save a portion of the property from lumbering so that the members could have a retreat for hunting and fishing. With a two-year lease, they rented the land at a nominal fee from the iron and steel company. The following year they decided to lease all 104,000 acres, although this did not exclude lumbering. They incorporated as the Adirondack Club in January, 1877, probably the first of many such private camps to appear in the region. The primary activity was fishing, and the club took over the old school house and Church of Tubal Cain as their hatchery for the stocking program. At one time, the owners arranged to bring in three moose from Maine, but the huge creatures died shortly after their arrival. The club members enjoyed no more luck than Henderson had in this regard. The old boarding house served as the clubhouse, while the members erected individual camps. With the end of the lease in 1898, they changed the name to the Tahawus Club, the name still retained in 1978.[10]

Apart from the club, which represented a whole new chapter in the general history of the Adirondacks, centered around organized recreation in the Great Camps, the works themselves stood undisturbed through the 1880s. Only a few photographers left any evidence of a visit - that being their work, several prints of which are included with the report. But in the 1890s, some hopes for opening the works again began to flutter. James MacNaughton, McIntyre's grandson via his daughter Caroline, enlisted the assistance of a French metallurgist named Auguste J. Rossi to ascertain what the prospects of the property really were. Rossi was born in Paris in 1839 and schooled at the Ecole Centrale of Arts and Manufacturers. He served as an assistant engineer on an English railroad project from 1862 - 64, followed by a stint as chemist at the Burnton War Works of Fuller Lord & Company. In 1876 he emigrated to the United States. In this country, Rossi ran the New York Ice Machine Company until 1890, when he began the work in titanium that attracted MacNaughton's interest.[11]

McIntyre's grandson wanted Rossi to assess the technical problems of using titaniferous iron ores. Convinced after visits to the property, examination of the original owners' correspondence, and experiments carried out from February to June, 1892, Rossi began a push for the acceptance of the use of titanium-tainted iron ores. As a disciple for these iron ores, he published articles in the Transactions of the American Institute of Mining Engineers, of which he was a charter member, as well as articles in trade journals like The Iron Age.[12] Indirectly, he became an ambassador for the use of the McIntyre ores. He stated his object in one of his papers.

> The use of titaniferous ores in the blast-furnace has been the subject of much controversy for many years. Divers objections have been raised against them, and, for one cause or another, the verdict had been so unfavorable that they have been excluded from the practice of iron-masters. This vexed question is, however, well worth a thorough and impartial investigation, in view of the immense deposits of such ores found in many parts of Europe, in New Zealand, in Canada, and especially (which interests us most) in nearly all the States of the Union. These ores when decidedly titaniferous, are generally free from phosphorous and frequently also from sulfur, and many of them being very rich in iron even when high in titanic acid, would constitute a valuable supply for the manufacture of iron, could the objections to their use be proved to be exaggerated, or be removed.[13]

Using the "New" furnace as a test case, Rossi argued that titaniferous ores were indeed workable. He cited other instances, including one notable English example, of working such ores with success.[14] But Rossi went beyond that, to run a series of tests during the summer of 1895 using the McIntyre ores. He built a 20-foot stack, open-top, with a 4½ foot bosh diameter. He first ran the stack on Lake Superior hematites for a comparison standard, then switched to the Adirondac magnetites. The results proved iron could be run out of the titaniferous ores. Those ores ran faster, with a more liquid slag, using less fuel, than the Lake Superior ores. The furnace did not experience any of the usual difficulties attributed to titanium dioxide in the iron ores. Moreover, the iron bars produced were of excellent quality and possessed extreme hardness. The key to his success, he argued, was a moderate volume of blast.[15]

Rossi apparently made his point, for he was supported in his stand by other metallurgists. In the discussion of the 1893 AIME paper, William Phillips asked rhetorically,

> Now the question is, how long will American metallurgists cling to their opinion that these ores cannot be profitably treated? Mr. Rossi has shown that they are neither infusible nor especially refractory; he has exhibited samples of slags containing 40 per cent of titanic acid, and their

> general appearance is proof that they have been in a state of complete fusion. He does not claim that his experiments are conclusive, but he does claim, and with good reason, that the verdict against these ores is unjust, based on entirely insufficient grounds, and far from creditable to the progressive spirit of American metallurgy.
>
> It is high time we turned our faces from the past, and confronted present conditions, and I, for one, believe that in the smelting of titaniferous ores there is abundant promise of success. The preparation of iron of great toughness, and the production of a special grade of iron, open-hearth stock in particular, hold out inducements of no ordinary kind. We await with interest whatever Mr. Rossi may hereafter be able to tell us of his further treatment of these ores.[16]

More important than the professional support for his stand was his impact on the affairs of the company for which MacNaughton served as caretaker. It took a number of years, but eventually MacNaughton found his buyer. Wallace T. Foote purchased the shares of the company owned by the heirs of McIntyre, Robertson, and Henderson. MacNaughton had rearranged the corporate structure in 1894, renaming the concern the MacIntyre Iron Company, with a capitalization of $160,000. With the sale of the property to Foote, Archibald McIntyre's original dream came true. Still, various heirs, notably Arthur Masten supported Foote.

The new owners' hopes were spelled out in an article in The Iron Age a couple of years after their purchase. Rossi's work had pointed out the great value of the ore and the feasibility of working it. Still, nothing had been done to exploit the vast iron deposits.

Despite Rossi's successes, American steel companies refused to use the titanium-tainted ores. But Foote hoped to change that situation.

> Mr. Rossi's work done at a time when those furnace managers to whom ores of this character would be naturally offered were not as keenly interested in possible sources of supply, since the concentration of Lake ores in a few hands had not gone as far as it has now, and they were not at the mercy of Lake ores interests then, as they now are, their chief competitors as producers of pig metals.
>
> It is better understood now than it was then, and improvements in fuel consumption and in the utilization of fuel have gone apace in the mean time, so that given ore at low prices, iron and steel can be made in the East as cheaply as at Pittsburgh, and local works have

> the clear profit of the handicap of freight to Eastern markets under which that famous producing center lies. The utilization of titaniferous ores, of which there are more than one large deposit in the Adirondack region, will contribute materially to that end.[17]

Foote thus saw a gap in the market he believed the Adirondac ore could fill. But he still faced the prejudice of blast furnace operators, despite Rossi's tests. So he continued a program of trials, using the magnetic concentrator of the Witherbee, Sherman & Company at Mineville, near Port Henry, New York. In December, 1906, Foote arranged the shipment of 23 tons of the Sanford Hill ore to Mineville. The trial produced from ores with a 51% Fe and 13% $TiO_2$ content a concentrate with a 60.28% Fe and 6.08% $TiO_2$ Similar tests were conducted in 1908.[18]

In the meantime, Foote began an extensive test boring project, using diamond drills to core a large portion of the 66,000 acres that now made up the iron company's holdings. Moreover, Bethlehem Steel ran a blast furnace test utilizing 1,500 tons of the MacIntyre ore. By 1908, the company had evolved an extensive preliminary report showing the cost of development of the ore resources at various levels of output, ranging from $1,207,225.90 for a 500,000 ton concentrating plant, to $1,720,074.77 for a 1,000,000-ton capacity. Their hopes had to have been raised by a feeler from Bethlehem Steel to supply one million tons annually. Apparently that blast furnace trial had gone well. Still the mining company figures commercial-scale trials were the only way to overcome the set perceptions of American iron producers. Already, though, the company had expended $101,135.73 between Foote's purchase in February, 1906, and late September, 1908.[19]

Things moved on through 1909 with more diamond drill sampling. Then came a tragedy in 1910; Wallace Foote died. The Vice-President, Arthur Masten, had this eulogy in the company's 1912 report.

> Mr. Foote's knowledge of the details of iron mining and manufacturing, his wide acquaintance throughout the trade and his unwavering belief in the great intrinsic value of our property and its immediate commercial possibilities, gave him unusual qualifications for the difficult task he assumed in taking charge of this enterprise. A widespread distrust of titaniferous ores has always presented a serious obstacle to its development. To a change of sentiment in this regard the personal efforts of Mr. Foote were very largely directed and with marked success. By his untimely death before these efforts bore substantial fruit the Company, to the interests of which he was warmly devoted, has sustained a severe loss.

With Foote's death, development work ground to a halt, because of a shortage of funds. The key lack remained a railroad, but without the backing of a supporter with adequate financial resources, all hopes for a rail connection were doomed. Prospects, Masten had to report, remained glum.

> As to the future prospects of the Company there is little to be said of encouraging character. The general business conditions, and particularly those in the iron and steel trade, have not been such as to favor developments involving large investments. On the contrary, the general tendency is toward retrenchment. We have had negotiations from time to time with one large consumer of ore looking toward the making of contracts on a royalty basis and providing at the same time for financing the construction of our railroad. These negotiations have resulted in nothing...
>
> The cessation of practically all development has reduced expenses to the lowest basis possible. The only work in progress is a magnetic survey undertaken with the view of completing the work done in the years 1907 to 1910 and plotting out if possible all the ore bodies on the Company's property. The cost of this will be approximately $2,000. The officers of the Company, although required to give considerable time to its affairs, are serving without compensation. Only such expenditures are as imperatively necessary are being made in connection with the railroad. Under these circumstances, it is hoped that with the funds now in hand and such as may be available during the ensuing year the Board can manage to meet the necessary requirements of the Company until such time as better trade conditions prevail or opportunity arises to enlist the cooperation of interests financially able to provide for the immediate development of the property.[21]

Suddenly the gloom lifted during 1913. Perhaps the war prospects freed the wallets of potential consumers. And help also seemed to arrive from the Buffalo-based Titanium Alloy Manufacturing Company, formed by Rossi in 1906. Wherever the iron company found the funds, it used them to begin construction of a mill and concentrator, a power house, and a loading dock at North Creek. The company also began mining - actually quarrying - the ore. The plan called for production of 10,000 tons of concentrates for use in a furnace test in Port Henry. Using four Phoenix steam-powered log-hauling tractors towing trailers of concentrate - then later ore - the company moved the iron to the railroad in North Creek for shipment to Lake Champlain.[22]

The destination of the ore was Port Henry, where the MacIntyre Iron Company had leased a furnace from the Northern Iron Company. They retained

F. E. Bachmen, "...one of the foremost blast furnacemen in this country" to actually conduct the trial, which ran from January 1st, to July 1st, later extended to August 1, 1914. During that time, the furnace operated just as Rossi had predicted, without any of the feared problems usually associated with titanium. As Bachman observed, "The troubles and difficulties met in the experimental run which I have just outlined were as nothing compared with those which were met during the first three months of the operation of the Port Henry furnace on all magnetic ores."

Bachman listed the following conclusions about working titaniferous ores on a commercial scale. He found a lesser expenditure of heat reduced the ores, because a greater proportion of oxygen was released by the carbon monoxide in the furnace. The furnace produced more slag, and a more fluid slag, with the MacIntyre ores than those without $TiO_2$. Significantly, he added, "The operation of the furnace above the tuyere level will be more uniform and there will be less tendency to hang and slip." These points had been major complaints about the ores, but Bachman dispelled them. Moreover, the iron produced was often a somewhat better quality than from the non-titaniferous ores. It contained less silicon and sulphur. Tests of bars from the ore indicated that the iron was stronger, and samples sent to commercial users did not produce a single complaint.[24] Clearly, the MacIntyre ores did after a great potential if only they could be shipped cheaply.

The iron company had taken another tack at winning approval for their ores the year before they engaged Bachman. The American Sheet & Tin Plate Company in Pittsburgh agreed to try the titaniferous magnetites in an open hearth furnace, in place of Vermillion ores from Lake Superior. The test involved working in acid and basic open hearths. The basic unit turned out a very good steel with an excellent surface appearance, and ran a good slag. The acid furnace used 1/3 more ore and required 50% longer in melting and feeding, compared to the Vermillion ores. The metallurgist concluded

> We will say that it is possible to use the Adirondack Titaniferous Ore in both the Acid and Basic Open Hearth practice, the production of steel from the furnace would, however, be less than could be obtained by using the Vermillion Ore, and the quality of the product is not sufficiently superior to justify its adoption.
>
> The Titanium oxide in the ore was not reduced to metallic Titanium in the bath, and the only benefit it seemed to have was to produce a more liquid slag without the use of fluorspar and seemed to have a little more affinity in reducing the sulfur in the Basic furnace...
>
> This is not an ore we would recommend to any Open Hearth Department for general use if it was expected of them to compare in output with other plants of the steel corporation. We do believe, however, that the use of this ore will produce steel of quality as its action in the furnace cannot be hastened at the will of the furnace-man, and the

> element time is a good thing in the working out of iron ore additions to the bath.[25]

Despite these two successful tests proving that commercial-scale use of their ores was perfectly feasible, and even offered certain advantages, no benefit accrued to the MacIntyre Iron Company. Perhaps the First World War diverted attention from the firm, for the shift to war production consumed nearly all interest. But even after the war, in the booming 1920s, the MacIntyre Iron Company could not attract enough interest to raise money for further development, or for railroad construction. A prospectus published in about 1922 laid out the results of all the tests and summarized work done to that time. The work of geologists had supplemented Emmon's 1830s estimates of the quantity of ore available and the potential totals were indeed immense. The iron company also considered market possibilities for the iron, and for the first time mentioned ilmenite as a product of the mine. Rossi was the key person in that endeavor. The Franch metallurgist had put his work with titanium and titanium dioxide to good use. In some ways, Rossi resembled Dixon, with his range of outside interests. His patents ranged from ice and refrigeration to metallurgy. He invented alloys for steel, a treatment for rails and structural iron, and a pigment from titanicoid. The Titanium Alloy Manufacturing Company was based on his works, primarily for the production of a ferrotitanium alloying agent. Rossi's development of the use of titanium dioxide as a pigment, however, offered the greatest prospect. Called "Titanox", the National Lead Company had acquired the Titanium Alloy Manufacturing Company in order to control that patent. Titanium dioxide, it turned out, produced the best white pigment known. In the effort to attract attention to their porperty, the MacIntyre Iron Company emphasized the great market that ilmenite - the titanium dioxide ore - promised to have in the future. As the prospectus observed,

> It is believed that the reasonable assurance of the development of a market for considerable tonnages of ilmenite - and this fact is susceptible of complete demonstration within a very short space of time - is a most important factor in making the operation of the MacIntyre Iron Company's properties an attractive commercial proposition.[26]

This statement eventually proved to be prophetic, but not during the 1920s. The iron company tried mightily to gain financial backing. They reprinted Bachman's report to the American Iron and Steel Institute and distributed it widely. The test results of the Port Henry furnace also received a wide circulation in the trade press.[27] The prospectus mentioned above continued the effort through the 1920s, without success. The crash of 1929 ended, at least temporarily, the faint chances that had existed.

There are a number of fascinating similarities between the activities of the MacIntyre Iron Company's first 36 years and the earlier efforts of the Adirondack Iron and Steel Company. As the problems of turning the mineral wealth into a going concern had not changed, the basic concerns of the two firms had a common point. Most intriguing, however, was the similar manner in which men separated by 60 or more years approached those problems. Both groups of owners began with the same expansive hopes for the property, and committed heavy expenditures merely to prove the value of the property. Both companies entertained the idea that proof of the iron-making possibilities of the ore would entice buyers. To aid in the experiment to prove the property's value, both sets of proprietors turned to scientific men to aid their tests and trials. Moreover, the most important scientific men for each company behaved and acted for the company in identical fashions. Emmons in the 1830s and 1840s, and Rossi in the 1890s and 1900s served not just as consultants, but actively boasted the prospects of their client through the publication of their reports. Emmon's tacit role as representative of the State of New York also had a counterpart in David Newland, who as a state geologist published an annual report in the New York State Museum Bulletin. These accounts not only provided a running story of the progress of the work at Adirondac, but also urged commercial trials to prove the ore's value. Newland, like Emmons, advocated the commercial development of the mine from a position as a State representative, thereby lending an aura of official approval to his statements.[28]

The two companies utilized the work of their scientific consultants in similar ways. But transportation remained the primary stumbling block to successful operation. So as the owners in the 1840s had done, the MacIntyre Iron Company set their sights on attracting the backing of well-connected supporters to enable railroad construction to begin. And for both companies, that strategy failed. Nonetheless, both concerns exhibited the same sort of enthusiastic motivation. First James MacNaughton and then Wallace Foot responded to the challenge of overcoming the prejudice of American iron makers to the ore. In the Hendersonian manner, both brought an almost missionary fervor and zeal to their tasks. Over the long haul, the financial prospects certainly exerted their pull as a motivational factor on these men. But the challenge itself of winning their struggle seemed equally important in explaining their efforts. And to complete the Henderson parallel, Foote died just at the time when the company needed the firm hand of a committed and technically knowledgeable leader to bring the prospects of success to fruition.

The Henderson parallel also offered a valid comparison for the failures of the two firms after the unfortunate deaths of the most involved owners. In both cases the tug-of-war between retrenchment and further expansion could be seen. Yet each company reached what appeared to be their high points after Foote, or Henderson, had passed away. And the ultimate fate of the two concerns again resembled each other, as the financial investments were left to decay in the Adirondack forests while efforts continued to interest potential purchasers. Lumbering during the 1920s and 1930s was the only source of income. Finch, Pruyn & Company, the large Glens Falls lumber outfit, had either purchased land or timber rights to the company's property.[29] Only the Tahawus Club maintained a continuing presence.

But in the long run, the story of the MacIntyre Iron Company ended on a happy note, at least for the owners. As World War II raged, the submarined warfare of the Axis all but cut off the supply of ilmenite from the beach sands of Travancore, India.[30] As titanium dioxide had already become a vital material in American manufacturing, an alternative source had to be developed quickly. The MacIntyre mine offered that option, and in 1941, the National Lead Company purchased the MacIntyre Iron Company. They opened a mine, using open-pit quarrying techniques, built a concentrator with a 3,300-long ton daily capacity, and later added a sinter plant to prepare the magnetite for use by the steel industry. The crucial development, however, was the construction of a railroad line north from the end of the Delaware and Hudson Railroad's spur at North Hudson. That 29-mile rail link, after it reached the MacIntyre Development, as National Lead named it, in 1944, made all the difference in the successful operation of the mine. After a century of effort, the transportation artery dreamed of by every speculator and booster had arrived.

The fairy-godmother character of this whole turn of events deserves emphasis. It seems a fair guess that without the war, there would have been no MacIntyre Development. Furthermore, without the assistance of the federal government, National Lead would not likely have embarked on the project alone. Not only did the federal government build the railroad and the sinter plant, but it also cleared away legal obstacles for the railroad's construction. The enabling legislation for the Adirondack Park at the turn of the century had specifically forbidden construction of railroads on state land. The direct route up the Hudson was thus closed to the MacIntyre Iron Company, which had surveyed a route to Lake Champlain almost twice as long as the Hudson River route. But under wartime pressures, a variance permitted the construction of the railroad via the Hudson River. The federal government built a large number of industrial facilities during the course of the war that it later turned over to the companies that had run those plants during the conflict. National Lead was not unusual, then, in receiving government assistance of this nature. But the fact of government involvement at the mine truly made possible an industrial development that would not have happened otherwise. In other words, only the necessity of wartime production offered a sufficient cause to build a railroad to the MacIntyre Mine. This situation should demonstrate how truly visionary every other scheme to open a rail line to Adirondac, or Tahawus as it was now called, had been.

Once the railroad arrived, the future of the mine was assured. Ironically, the ilmenite had become the most attractive feature of the mine, while the magnetite became a by-product. Bethlehem Steel used some of the sinter plant's output, but only reluctantly. The prejudice against titaniferous magnetites has continued. In 1978, the only outlet for the magnetites was a slurry component for use in the separation of coal and rock. Coal will float on a slurry, while the rock sinks, so this principle is used to separate the two. Magnetite is ideal for making the slurry, for even after crushing to a very fine dust it can be recovered magnetically and re-used.

National Lead, even with the arrival of the railroad, faced a few of the same problems encountered by its predecessors. Primarily, all living facilities had to be provided by the company, including housing for 180 families and 160 single men. A gymnasium, school, YMCA, roads, store and other facilities marked the tidy village of Tahawus. The company owned them all. But the absolute isolation of the region had been broken by the automobile. The

Tahawus Cloudsplitter offered a running account of the goings on at the village, but no story rivaled Dornburgh's boxing match during Porteous's tenure.[32]

Over the years, the Tahawus Development grew and expanded, as a scanning of the Cloudsplitter demonstrates. One intriguing feature was the way that the mining equipment grew in size from the 32-ton trucks of the late 1940s to the 100-ton units of 1978. By the 1960s, the original Sanford Hill pit, over 300 feet deep had reached the limit of economical working. So the entire village was moved 14 miles down the road into the village of Newcomb, forming a sub-division called Winebrook Hills. A second open pit was opened during 1963 where the village had stood, and became the sole source of ore in 1966. Use of the original hole as a tailings dump eliminated a persistent pollution problem on the Hudson River, for Lake Sanford all but disappeared as a settling pond for the black mill waste. Leakage of the waste into the river was solved by use of the original mine pit.

The 1960s were the heyday of the facility, which ships the ilmenite only for use in pigments. The economic downturn of the 1970s cut into both the output and employment at the mine. The sinter plant closed, and the mill was greatly altered. But the present pit offers another ten years of operation, and the ores on the remaining company property could furnish ilmenite well into the next century and beyond.

It took well over 100 years for the prospects first visualized by David Henderson in 1826 to emerge as a viable development. Fantastic efforts, and large amounts of money went into the plans and schemes, usually producing only frustration. But the 20th century development of the National Lead Company graphically demonstrated how the scale of technology has altered the balance in man's favor, as he confronts nature in search of mineral wealth. The problems of the Adirondack Iron and Steel Company paled against the size of the operation of the present mine. The machinery alone, or even the size of the open pit or waste rock piles at Tahawus seem to reduce the efforts of Henderson and company to insignificance. One comparison might be instructive - one Electra-Haul 100-ton truck such as used in 1978 could hold more than the entire average annual iron production of the iron works over its 25 year history. But while technology has advanced, one common point draws the two operations together, the vast human effort that went into both projects. Moreover, the MacIntyre Development represents the ultimate embodiment of the original proprietors dreams and hopes, shared by many others on the way. As such, the MacIntyre mine in 1978 is the lineal descendent of the Adirondack Iron and Steel Company.

1. James R. Thompson to James McIntyre, 11 January, 1860, MS 65-28, Box 5, Folder 20.

2. James R. Thompson to Samuel Cheever, 2 April, 1867, and other letters in MS 65-28, Box 2.

3. James R. Thompson to Samuel Cheevers, 14 November, 1868, MS 65-28, Box 3; James R. Thompson to Owners of the Adirondac Property, 8 June, 1875, MS 65-28, Box 2.

4. James Thompson to Gustavus Ricker, 14 December, 1881, McIntyre Correspondence, Volume II, p. 214, THS; Jr. R. Thompson to Samuel Cheevers, 14 November, 1868, MS 65-28, Box 3.

5. Lossing, (1859), p. 27.

6. Article published in Plattsburgh Republican on Iron Ore Properties, about 1873, Binder of typescript material, Witherbee Collection, Sherman Free Library, Port Henry, New York.

7. James R. Thompson to W. W. Durant, 25 February, 1881, McIntyre Correspondence, Black Notebook Volume II, p. 219, THS.

8. Jim Shaugnessy, Delaware & Hudson, (Berkeley, 1967).

9. Plattsburgh Republican, ca. 1873; See HAER Photos, #1 and 3.

10. Masten, (1968), pp. 175-187; Dornburgh, (1885), p. 72. MS 65-28, Box 5, Folder 24 and MS 74-18, Boxes 3 - 6 contain Masten's notes and proofs for his book, privately printed in 1935, entitled Tahawus Club, 1898-1933, and other information about the club. See HAER Photos 4, 7 and 31 for views of the Club during the 1880s, Photos 32 to 36 show views of water colors painted by R. H. Robertson, club member and relative of the original owners, about 1915.

11. Who's Who in Engineering, (New York, 1923), p. 1083.

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28 For example, see David H. Newland, "Geology of the Adirondack Magnetic Iron Ores," New York State Museum, Bulletin 119, (Albany, April, 1908); and "The Mining and Quarrying Industry of New York State," New York State Museum, Bulletin 120, (Albany, 1908). This last report appeared annually. Newland did not limit his publications to state journals, either, publishing in the trade engineering and mining journals as well.

29 MS 65-27 contains over 60 boxes of manuscript material related to the MacIntyre Iron Company's affairs, especially during this period.

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The following people and institutions have provided research assistance in the course of preparing this report.

The Adirondack Museum Library, McIntyre Papers,
- MS 61-62
- MS 65-22
- MS 65-27
- MS 65-28
- MS 67-12
- MS 74-18

These papers served as the core of the information about the Adirondack Iron and Steel Company, and without them, there would be very little to tell of that firm's history. Almost all of the material consists of letters to or from Archibald McIntyre. His correspondants were the partners in the firm and the works managers. With the exception of the inevitable few gaps, the letters cover the entire span of the company's existence.

The Adirondack Museum not only was a co-sponsor of this HAER project, but went out of its way to provide the type of assistance that permits the successful completion of such documentation projects. Special thanks go to Craig Gilborn, Museum Director, and to Ms. Marcia Smith, Librarian, who had catalogued and organized all of the manuscript material, greatly easing the task of research.

Ticonderoga Historical Society, Ticonderoga, New York.

Before the New York Historical Association moved its headquarters to Cooperstown, New York, portions of the McIntyre papers were deposited in the Hancock House, now owned by the Historical Society. Several important items of information relating to the iron work's operation remain in the collection, such as the contract for the blowing machinery at the "New" furnace. Elizabeth McCaughlin, Curator, was especially helpful in finding this information, and I would like to extend a special thanks for her assistance.

Sherman Free Library, Port Henry, New York.

The Sherman Library has a collection of material related to the iron industry of the Lake Champlain region, called the Witherbee Collection, after one of the families most involved in that industry at the end of the nineteenth century. Mrs. Kathleen Brooks, Librarian, was very cooperative in granting me access to this material.

Lake Placid-North Elba Historical Society, Lake Placid, New York.

Ms. Mary MacKenzie, Director of the society and editor of the society's <u>Placid Pioneer</u>, has spent several years working on the history of the Lake Placid region, and graciously permitted me to read her unpublished manuscript on the history of the Town of North Elba. This information was especially helpful for the early McIntyre forge operated in North Elba.

The National Archives, Washington, D.C.
Series 1351, Records of the Office of the Chief of Ordnance, Record Group 156, National Archives Building.

Jersey City Public Library, Jersey City, New Jersey.

Talking with J. Owen Grundy, City Historian, and Joan F. Doherty, New Jersey Room, proved very helpful in obtaining information about David Henderson and the steel works in this city.

Historical Society Of the Town of Minerva, Minerva, New York,
Mrs. Clarence E. Jones, Director,

Franklin Institute, Philadelphia, Pennsylvania.

Committee on Science and the Arts Records, CSA-507.
This report was a statement about tests run by the Institute on samples of the cast steel produced by Dixon in 1849.

Fort Edward Historical Society, Fort Edward, New York.

* * *

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Richie Youngkin, Penfield Foundation, Mineville, New York.

Richie started the ball rolling on this project during the time he worked as an NEH intern at the Adirondack Museum in 1977. He not only drew the attention of the Historic American Engineering Record to this site, he also did the preliminary research and mapping of the site. His assistance on sources and locations was invaluable. His survey maps remain on file at the Adirondack Museum, and include data on the 1844 blast furnace and village that could not be included in the HAER team drawings in 1978.

Arthur Crocker, President of the Association for the Protection of the Adirondacks, 21East 40th Street, Room 704, New York, New York, 10016.

Mr. Crocker is a relative of Arthur Masten, who wrote the first history of the Works, and thus traces his line back to McIntyre himself. He is a member of the Tahawus Club and thoroughly acquainted with the history of that organization. The information he provided was helpful, but even better were the old photographs and original paintings, by R. H. Robertson, that showed both the iron works and the club. These pictorial sources have been photocopied and are included with the report.

Walter Chapman, Mine Manager, McIntyre Development, NL Industries Tahawus, New York.

Mr. Chapman was instrumental in obtaining the resources necessary for the team's research. But more importantly, he and the NL Industries mine at Tahawus served as the host for the architects. The willing support and assistance that the entire staff at the mine provided made the survey project move along with greater ease than would otherwise have been possible. "Chappie's" interest in the historical background of his concern is admirable, a trait that might be copied by more business managers.

# APPENDIX

This appendix contains detailed descriptions for each of the measured drawings that accompany this report, except those drawings already provided with explanations. They also cover the actual blast furnace operations in greater detail.

## Drawing 4 of 13
## Furnace Plan

Hearth Section:

This plan of the stack emphasizes the basic configuration of the foundation. Four separate stone masonry piers carried the structure, which sat on a leveled platform at the base of a hill. Iron tie rods running through the piers and stack held the structure together through the cycles of severe expansion and contraction experienced by all blast furnaces. Four brick archways connected the piers, allowing access to the hearth. The hearth, built of large stone blocks, almost certainly sandstone, held the molten iron formed in the furnace.

This blast furnace was fired with charcoal, and the air blast that supported combustion was pre-heated in a stove on top of the furnace. The hot air passed from the stove through a "downcomer" and into a "bustle" or "belly" pipe. From the hustle pipe it ran through blast pipes, one of which was found, and into three tuyeres. The tuyeres projected into the furnace through slots cut into the sandstone hearth, and they were held in place with fire brick and fire clay. Because this furnace used hot blast, the cast-iron tuyeres were water-cooled to prevent them from melting. A pump in the wheelhouse circulated water from the river to a water jacket encircling each nozzle.

The furnace hearth was located at the bottom of the bosh, below the level of the tuyeres. This rectangular space held the molten iron. At the three tuyere arches, solid stone blocks lined the hearth. But on the fourth side, openings in the stone gave access to the furnace interior. One of these holes was in the dam stone. Twice a day furnacemen tapped the hearth by removing a fire-clay plug in the dam stone. An iron channel, or runner, carried the liquid iron to a bed of sand in the casting house. A trough in the sand, called the sow, directed the molten iron into molds known as pigs. Thus, the end product was called pig iron.

Top Section:

The top of the stack was originally reached by a covered charging bridge stretching from the hillside west of the stack. A simple frame structure called a "top house" covered the entire bridge. Here "topmen" prepared the charcoal, flux and crushed iron ore that made up a charge. They fed the charge through a hatch at the base of the draft stack, and it fell into the "tunnel head", or the top of the furnace.

The hot-blast stove also sat on top of the stack. Here the air blast that enabled the furnace to melt iron was preheated, a measure that significantly increased the efficiency of the charcoal fuel. A galvanized sheet iron air main conveyed the air from the blowing cylinders to the north end of the stove. The stove itself consisted of a common brick shell enclosing a network of cast-iron piping through which the blast air circulated. Hot gases from the ironsmelting process entered the shell of the stove via a pair of flues running from the tunnel head. Four chimneys with dampers controlled the flow of gases through the shell. By the time the air entered the cast-iron downcomer at the south end of the stove, the blast was heated, perhaps to 450-500$^{o}$.

Drawing 5 of 13

Front or Hearth Arch - East Elevation

The front arch was the scene of most of the activity at the furnace, for here the furnacemaster and "guttermen" or "firemen" tapped the hearth where the molten iron pooled behind the "dam stone." Reaching almost to the level of the dam stone, but leaving a gap of a few inches, was the "tymp stone" that continued the line of the hearth to the bottom of the bosh. Water-cooled iron plates covered the exterior faces of the tymp and dam stones to protect them from the workers' tools. Normally the gap between these stones was packed with fire clay to hold in the heat. But twice daily, the dam stone was uncovered, and the iron ran out of the hearth. First, the molten slag floating on the iron was tapped off. The slag runner carried the slag, consisting of the liquid silica and flux, toward the casting house, for eventual removal to the slag dump above the wharf. Then after unblocking the tap hole in the dam stone, the furnacemen admitted the liquid metal into the iron runner, a cast-iron channel that guided the iron into molds in the sand on the casting house floor. This procedure, repeated about every 12 hours at Adirondac, may have produced about six tons of iron at a time.

The archway over the hearth area was slightly larger than those over the tuyeres. To cover the three-foot greater span, an iron lintel supported the stone above the brick arch. Standard furnace practice was to have a sow from another furnace cast to size.

Directly over the hearth arch on top of the stack was the hot blast stove. The blast air circulated through two sets of 18 cast-iron, V-shaped retorts, divided by a fire brick wall, inside the common brick shell of the stove. A set of iron tie bars held the shell intact despite the stresses of heating and cooling. The retorts were heated by the waste gas from the furnace, in turn transferring heat to the blast air. The galvanized sheet iron air main conducted the air from the blowers up the north face of the stack. The cast-iron downcomer carried the heated air down the south wall to the "bustle" pipe.

## Drawing 6 of 13

### Tuyere Arch - South Elevation

This blast furnace is an exceptional example of the furnaces built during the transitional period at the beginning of the age of coal and coke smelting. The technical developments associated with these new fuels can be seen in the stack and machinery at Adirondac. The blowing cylinders are one such feature; here wooden tubs have been replaced by iron cylinders. The height of the stack is another indication of change. Until 1840, few charcoal furnaces exceeded 30 feet. For example, the 1844 furnace at the Upper Works was only about 20 feet high - perhaps later raised to 30 feet. In contrast, the 48-foot "New Furnace" matched the height of the newest furnaces then being built to smelt iron using anthracite coal.

Yet apart from its height, the construction of the "New Furnace" nearly fit the typical design of charcoal blast furnaces, if there was such a thing. Apart from basic outlines, each millwright, mason, or furnacemaster could be counted on to incorporate his own ideas as to what made a blast furnace work well. So no two blast furnaces of the pre-1860 era ever looked alike.

The stack exterior consists of large stone block masonry filled with mortor, with small stones filling the uneven gaps between the larger stones. Almost certainly the piers are rubble-filled, rather than solid masonry. The stone was locally quarried anorthosite. A large number of tie rods and anchor bars, all secured with wedges, helped the stack withstand the expansion caused by the furnace's intense heat.

There are some noteworthy contrasts in the level of craftsmanship exhibited on this structure. Great care was taken to dress the corners of the stack. The number of tie rods also demonstrated special concern for structural stability. Yet while the mason gave some thought to the appearance of the brick entablatures at the tuyere arches, as seen in the arch surmounted by the corbelled panel in photograph 30, he laid the brick rather sloppily. Yet the brick archways between each pier were interestingly executed, with a layer of fire brick covering two courses of common brick, perhaps for heat protection. (See photographs 26-28) But it is interesting that the only area exposed to very high heat was the front arch. Perhaps the masons merely copied the pattern used at the hearth arch in the tuyere arches to achieve a uniform appearance, or because they liked the pattern. In general, mechanical features seem to have been handled with a high degree of precision and attention to detail while wooden structures came in for far less effort. But the signs of a concerned craftsman are still occassionally discernable.

## Drawing 7 of 13

### Vertical Section of Furnace Stack

When the "New Furnace" is seen split down the center, the typical iron furnace shape of two truncated cones placed based to base becomes apparent.

As in other features, this 1850s-vintage iron smelter exhibited the influences of the technical changes then occurring within the American iron industry. The slope of the bosh - the lower cone - is steeper than in most charcoal furnaces. This comparison with older furnaces also demonstrates the greater height of the stack at Adirondac.

Another indication of the progressive design of this installation was the use of a hot blast stove, heated by waste gases from the stack. Invented in England in 1828 by James Neilson, this type of stove had been pioneered in this country less than 15 years earlier. This Neilson type remained predominant until the regenerative brick stove appeared in the 1860s. The blast air was channelled through the V-shaped cast-iron retorts by baffles in the horizontal mains. The passageways in the stove's floor caused the even circulation of the waste heat. Doorways in the ends of the brick shell allowed the removal of the ash and dust from the pipes and passageways, thus preventing the burning up of the retorts.

Utilization of the hot blast lowered the amount of charcoal needed to produce a tone of iron by up to 20%. Moreover, the use of hot blast forced the adoption of another technical innovation - water-cooled tuyeres. The stoves of this type could heat the blast to 600-700°F, although 400-500° might be a more reasonable conjecture for this installation. Such a heat raised the furnace temperature enough to melt any unprotected tuyeres, and without care, even water-cooled tuyeres could melt. A further protection against this problem was the poker rod that ran through the blast pipe to prevent the nozzle from being blocked. A surviving tuyere and blast pipe showed these features.

The actual manufacture of iron remained an arcane art through the whole period that the Adirondack Iron and Steel company operated. One baffling problem revolved around the presence of other elements, like titanium, in the iron ore. The iron masters responded by experimenting with the amount of blast, the angle of the tuyeres, the composition of the charge, and the type of flux. Blast furnaces were balky and finicky, literally possessing individual personalities. The "New Furnace" must have been no different.

By 1840, or even earlier, a basic understanding of the chemical reactions involved in iron smelting had been reached. Although many riddles remained, and still do, the furnacemaster knew that the combustion of charcoal in the blast produced carbon monoxide and heat. This reducing atmosphere liberated the oxygen from the ore, while the now-molten ore settled into the hearth. This process began as the ore, the charcoal, and the flux used to promote the formation of slag worked down the inside of the stack. As they neared the bosh, the materials actually circulated within the stack. The key to successful smelting was the air blast that enabled the charcoal to burn hot enough to melt the iron, which happened near the tuyeres. Here the furnace was hottest, reaching about 2500°F. To deal with this heat, the "inwall" - the brick lining above the hearth - and bosh were built of firebrick, laid as headers, backed by layers of fireclay, rubble fill, and another course of brick. The hearth was constructed of large sandstone block with refractory characteristics. The very thick bottom stone served as the foundation for the whole affair. Side and back stones formed the rectangular hearth, before the bell-shaped bosh began. The damstone held in the molten iron, while the tymp almost closed the hearth in front. The tuyeres protruded six inches into the hearth, and like the tymp and dam were water-cooled.

Drawing 9 of 13

Wheel House Plan

The primary mechanical feature of the "New Furnace" at Adirondac was the water-powered blowing engine for providing blast air to the stack, without which the high temperatures to melt the iron could not have been reached. In August, 1850, the works manager signed an agreement with the Hudson River Iron and Machine Company of Fort Edward, New York, for the purchase of four cast-iron blowing cylinders and the water wheel to drive them. But not until the first part of 1854 did the machinery reach the works. The cylinders, alone, 44 inches in diameter and 66 inches long, cost $1,900, a figure that included the transportation of the pieces across 80 miles of wilderness to the site.

This equipment was an interesting mix of old and new developments in the technology of iron-smelting. By 1850, horizontal iron cylinders had begun to replace the vertical wooden tubs common to earlier blast furnaces, as part of the more general transition to steam power and coal fuel. The coal furnaces required a more powerful blast to attain the higher temperatures necessary to reduce the iron. Steam engines powering horizontal, double-acting cylinders provided that blast, because with two power strokes, the horizontal cylinders did not waste a stroke like the vertical cylinders that pushed air only on the piston's upstroke. Ideally one horizontal cylinder could replace two vertical tubs. The installation of four iron cylinders at Adirondac reflected both the common practice of the time of over-engineering machinery and the optimistic hopes of erecting a second furnace. Each Adirondac cylinder could pump 5000 cubic feet of air per minute, and the cylinders were arranged to work in pairs. Clearly a large degree of excess capacity was built into this installation, for 4000 cubic feet would have been more than adequate.

Double-acting cylinders also offered the advantage of assuring a more constant blast of air - an important factor in maintaining an even temperature in the stack. When two cylinders were operated with the cranks opposed at a 90$^{o}$ angle, there was no dead spot in the blast. The pressure fluctuated very little.

The components chosen to make up the blowing engine are indicative of the proprietors' approach to innovation. The iron cylinders were usually matched with a steam engine. But the builder at Adirondac chose to adopt only half of this combination, sticking with the traditional overshot water wheel while opting for the more advanced iron cylinders. The isolation of the Adirondack region and the possible unfamiliarity of local millwrights with the new steam technology may account for this particular choice, but the generally adequate water supply made this a perfectly logical decision.

The water wheel was an interesting composite iron-and-wood structure that reflected the generally high level of awareness of technical changes exhibited at the "New Furnace". The end result was a mixed system well-fitted to the situation and conditions at Adirondac, based upon careful forethought rather than a blind effort to adopt, on a wholesale basis, the state of the art technology.

Drawing 10 of 13

Section of Wheelhouse, East View

The wheelhouse served as the mechanical hub of the "New Furnace", containing the water wheels, blowing cylinders, water pump, and power take-off to run the stampers on the charging bridge. The necessity to limit vibration among this equipment required heavy construction on the machinery floor. A timber flume carried water through the dam sluice and over the wheel. After turning the wheel, the water ran out of the wheel pit through five-foot wide bays under the machinery floor. These channels were at least four feet deep. Large stone slabs approximately ten feet long, three feet wide, and a foot thick formed the roof of these bays, as well as the floor foundation. Two intermediate stone piers, also five feet wide, enabled the slabs to cover the full floor of the building in three spans.

Atop this very solid footing, the company added a foot of round river stone of varying sizes. A facing of timber beams held this rubble-fill in place at the edge of the wheel pit. A layer of cement or mortar topped this stone fill to provide a level floor surface. On this cement, the brick piers for the crosshead guides were built and likewise the timber cribs that supported the blowers and the pillow blocks for the crankshafts. These cribs may have been filled with sand to further dampen vibration. The pillow blocks for the crankshafts and the rear of the blowing cylinders were bolted directly to the timber of the cribwork. But a pair of bolts anchored the front of each cylinder into the stone slabs of the underfooting. These cylinders remain firmly mounted. The result of this arrangement was an extremely solid platform for the machinery, in part explaining the splendid preservation of this equipment.

The actual structure over the machinery is far more a matter of conjecture. A frame building covered the wheel pit, machinery floor, and forebay, and was connected to the casting house by a short passageway. An 1859 sketch showed a small ventilator and a gable window on the wheelhouse roof. A fire destroyed all structural evidence at some point after the turn of the century. Nor do old photographs provide any details about this building, beyond verifying its existence. But without such a shed, winter operations would have been impossible. Only a heated facility would have prevented the water wheels from icing, a sure problem when winter temperatures may reach 25° or even 35° below zero.

Drawing 11 of 13

Section of Wheel House - West View

The water wheels used to power the machinery at the "New Furnace" were of composite wood andiron construction, reflecting the growing use of iron for all purposes through this period. This type of construction was not unusual by the 1850s, for improved durability and strength resulted from the use of iron as a structural element. The Hudson River Iron and Machine Company of Fort Edward, New York, built the wheels, just as they had the other machinery. The lack of perfect symmetry of the large wheel indicates the difficulties encountered when erecting a wheel at the site. The iron works chose to build overshot wheels, one to run the blowers, the other to power the ore stamps and water pump. But although both were 16 feet 4 inches in diameter, the actual construction of the wheels differed considerably.

The large wheel was 18 feet across the face with segment gears on both rims. The iron bands that supported these segments also held the shroud into which the buckets were morticed. The shroud was not solid, but consisted of smaller timbers bolted together. The interior circle of the iron segment band was not continuous, to allow the 12 spokes running from the 30-inch axle to be morticed into the shroud at these gaps. Three intermediate sets of iron bands were spaced across the outside diameter of wheel, dividing the buckets into four sections. A set of wrought-iron tie rods ran from one end of the wheel to the other, through the shrouds, pulling the wheel together. There were 16 rods, corresponding to one for each segment gear section.

The shaft of the wheel was wood, with a gudgeon driven onto each and for the bearing mount. An open-topped, babbitted bearing block held the shaft in place.

In contrast, the smaller wheel was only six feet eight inches long. The construction of the buckets, shroud, and segment gears were nearly identical. The face of the single segment gear was only seven inches wide instead of nine inches. But the differences were minimal in this regard. The main variation from the large wheel was the cast-iron shaft for the wheel. This axle carried spiders to mount the eight spokes. The spokes were not morticed into the shroud on the smaller wheel, but apparently were fastened onto plates attached to the cast-iron tie rods at the shroud.

These two different schemes of construction reflected the differing uses expected of the wheels. The smaller wheel was more lightly constructed as it had to drive only one crankshaft, and that against less force. Furthermore, the different materials chosen for axles represented the tempering of a desire for state of the art technology by a realistic awareness of the problems posed by geograhical isolation. The transportation of a 20-foot cast-iron shaft was totally impossible. Clearly the designer of the blowing engine and other machinery at the "New Furnace", be it a local millwright, the resident manager, or even the Hudson River Iron and Machine Company's machinist, was a careful pragmatist, not tied to any dogma of water wheel construction.

The actual operation of this blowing engine differed not at all from other water-powered air-blast systems at most contemporary blast furnaces. The flow of the Hudson River running through a wooden flume turned the 16-foot, 4-inch wheel. The water then exited through three bays under the machinery floor. Each of the segment gears on the rim of the wheel drove a 7-foot pinion gear mounted on the crank shaft.

The crank shaft moved the piston assemblies back and forth producing the blast. Just as was true of a steam engine, the piston rod had to remain parallel to the walls of the cylinder. For this reason, the piston rod was joined to the crank by a "connecting rod" and "crosshead", identical to the connection of a steam engine's piston with its flywheel. The crosshead travelled back and forth on a set of rails, called the "crosshead guides," that were mounted on brick piers at the proper elevation to keep the piston level. Only the connecting rod pivoted on the crosshead, as it followed the rotation of the crank. On each stroke of the piston, a flap valve on either head of the cylinder let air into the cylinder. The piston then forced it through a channel into a galvanized sheet iron air receiver. This reservoir, larger than the air main to the furnace, built up pressure that acted like a surge dome on a water pump, keeping a constant flow of air moving to the furnace. A manhole in the center of the receiver gave access to the interior and a safety valve may have been mounted on that hatch.

Drawing 13 of 13

## Piston Crank

The cranks now mounted on the crankshafts are not the original pieces. The contract specified cranks with balances, but they must have been replaced quite early by cranks that permitted adjustment of the piston stroke from 2½ feet to a maximum of 5 feet. The originals with counter weights were simply discarded and piles in a corner of the already cramped wheelhouse. Perhaps the ability to adjust the strokes was very important in affording extra flexibility to the ironmaster in his constant experiments to find the perfect amount and pressure of blast.

## Charcoal Cart

To move the charcoal from the storehouses near the end of the charging bridge, small carts with sheet metal bodies were used. At least parts of 3 of these carts remain scattered around the furnace site. A swinging gate made the job of dumping these wagons much easier.

## Air Main Control Valve

A sheet metal air main carried the blast air from the blowing cylinders to the north end of the furnace where it entered the hot blast stove. A large valve was fitted onto this main, probably somewhere on the wall of the casting house, so that the furnace master could control the flow of air to the furnace without having to go all the way in the wheel house to make his adjustments. A rack-and-pinion arrangement opened and closed the gate of the valve.

## Stamper Box

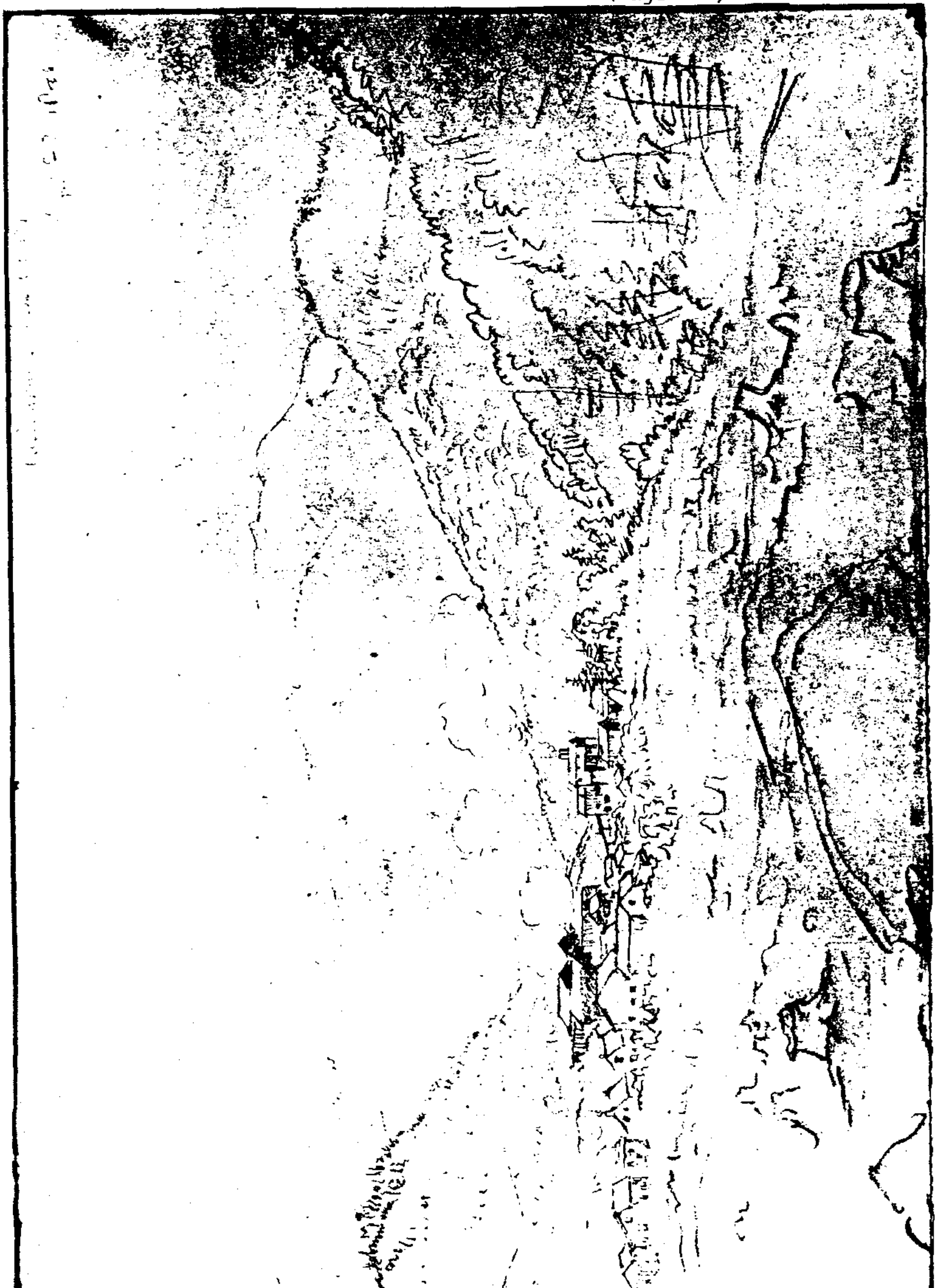
A set of drop stamps was located on the charging bridge to crush the iron ore into fine particles before the topmen charged the iron into the blast furnace. The works manager ordered this equipment from the Hudson River Iron and Machine Company at the same time that he ordered the blowing engine. Twelve drop stamps were arranged into two sets of 6, so that two boxes like this were needed. The ore was dumped into the box, and the cam-actuated stamps crushed the rock until it could fall through the grate bars built into the bottom of the box. The bars are now misshapen, showing the wear of the 6 stamps.

## Water Pump

Because of the need for cooling water at the tuyeres, damstone, and tympstone, a water pump was installed in the wheelhouse. A small shaft took power off the small water wheel, so that a leather belt could drive the pump. The pump was manufactured in New York by the Union Power Company, and was known as a Gwynne Patent Centrifigal Pump (Patented in 1851, the pump was exhibited at the New York Crystal Palace in 1853, where it served in there different capacities, including its use as a cologne pump in Mr. Phalon's Bower of Perfume). The pump at Adirondac has survived in remarkable condition, considering that it had rested half-submerged in mud for the last 50 years, at least. It has several nice decorative features, including the case and the brackets for the pulley support.

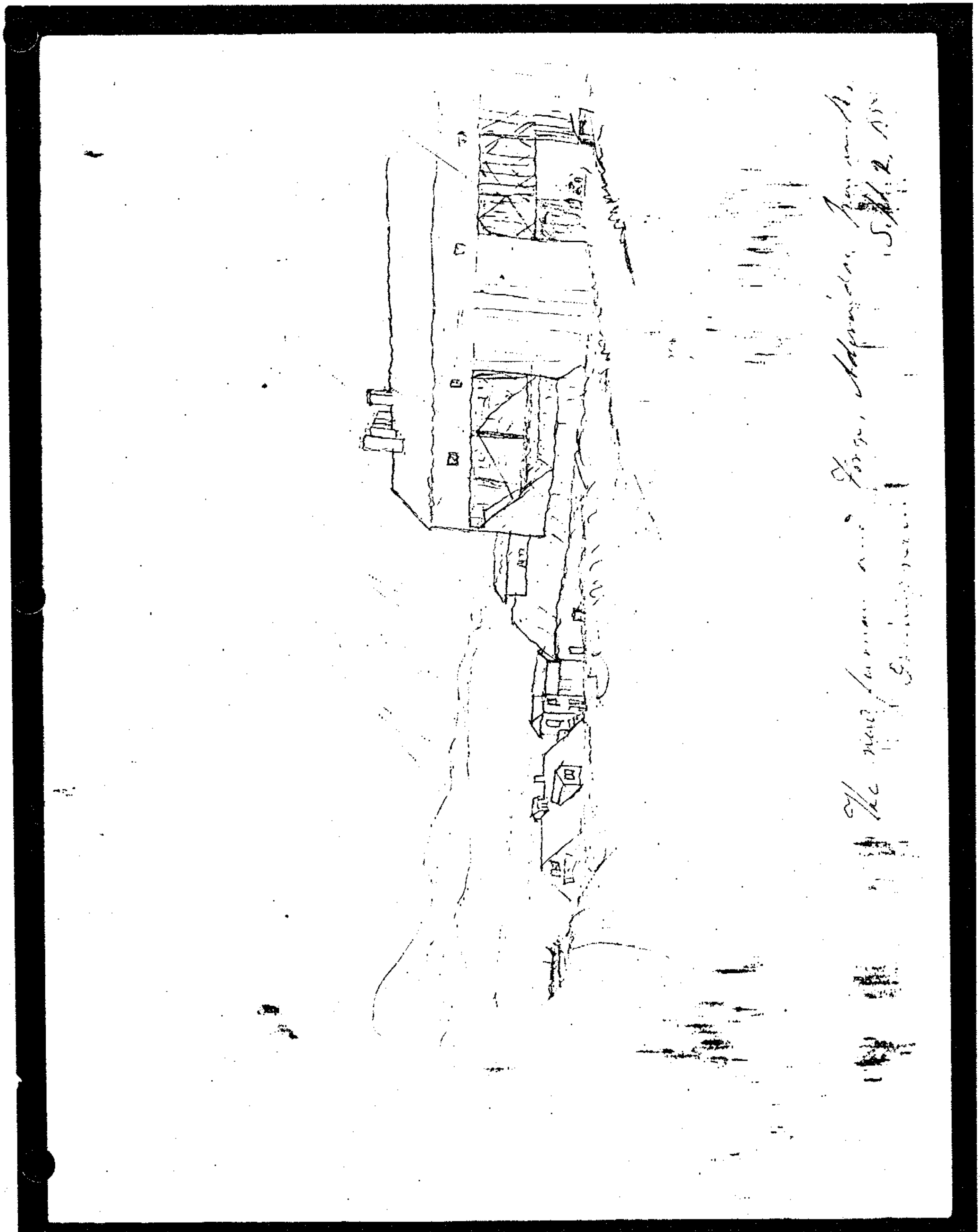
## Blast Pipe and Tuyere

Only one of the three blast pipes originally installed at the New Furnace has survived. But it still had the tuyere attached. The design of the blast pipe might well have been taken from Frederick Overman's treatise on the manufacture of iron. It consists of a finely-done casting that connected the bustle pipe with the furnace. It tapers at the furnace end, where the tuyere was attached. At the connection with the bustle pipe, there was a poker that ran the length of the pipe to enable the furnace master to keep the end of the tuyere from clogging. Two mica view screens were also set into this end of the pipe, for the furnace master's use. The water-cooled tuyere was detachable, so that in the not-uncommon event that the tuyere burned out because of the heat of the furnace, it could be replaced. Several melted tuyeres found at the site show that this did indeed happen.



A black and white, 8 x 10 photograph of the sketch can be obtained by writing to the Photographic Services Department, The Detroit Institue of Arts, 5200 Woodward Ave., Detroit, MI 48202.

Pencil sketch of Adirondack Iron Works by Thomas Cole, September 23, 1846, showing the 1844 Blast Furnace, the Forge, Charcoal Houses, and dwellings.



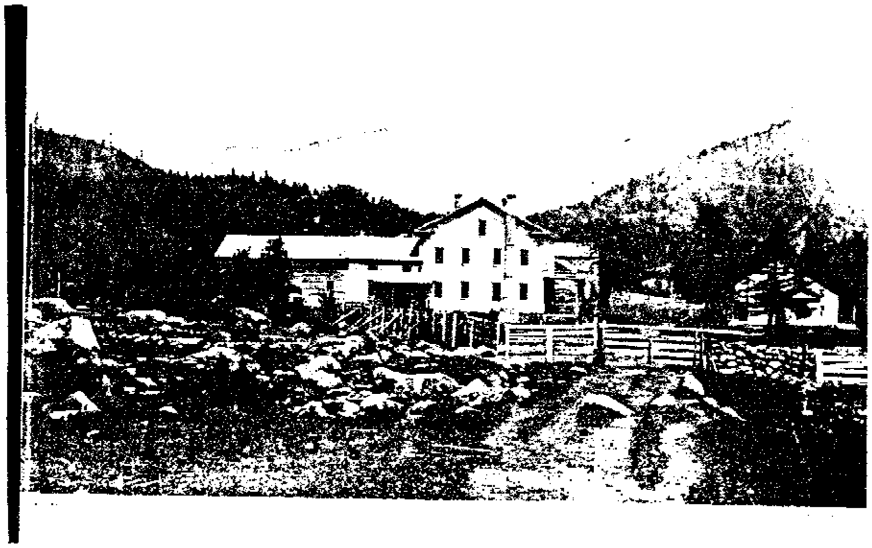
A photograph of the sketch can be obtained by writing to the Henry E. Huntington Library and Art Gallery, San Marino, California.

Copy of 1859 pencil sketch of the "New" Furnace and Forge done by Lossing.

Photocopy of a photograph. Photograph can be obtained by writing to The Adirondack Museum, Blue Mountain Lake, NY 12812.

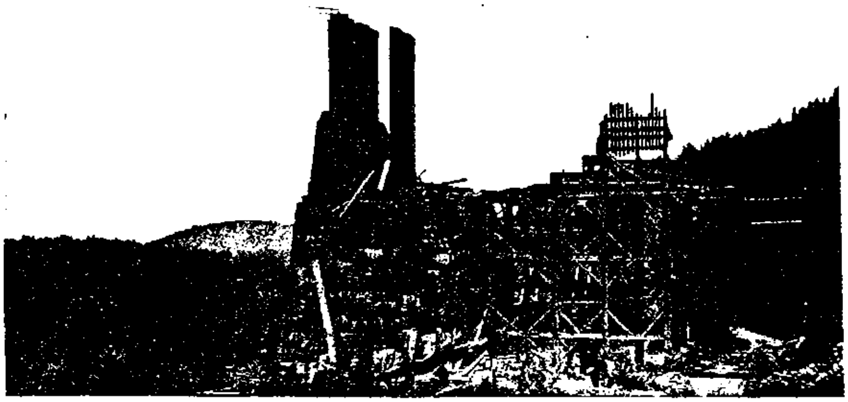
-E. Bierstadt, The Adirondacks: Artotype Views of the North Woods, NY, circa 1880's (n. d.).

Photocopy of a photograph. Photograph can be obtained by writing to The Adirondack Museum, Blue Mountain Lake, NY 12812.



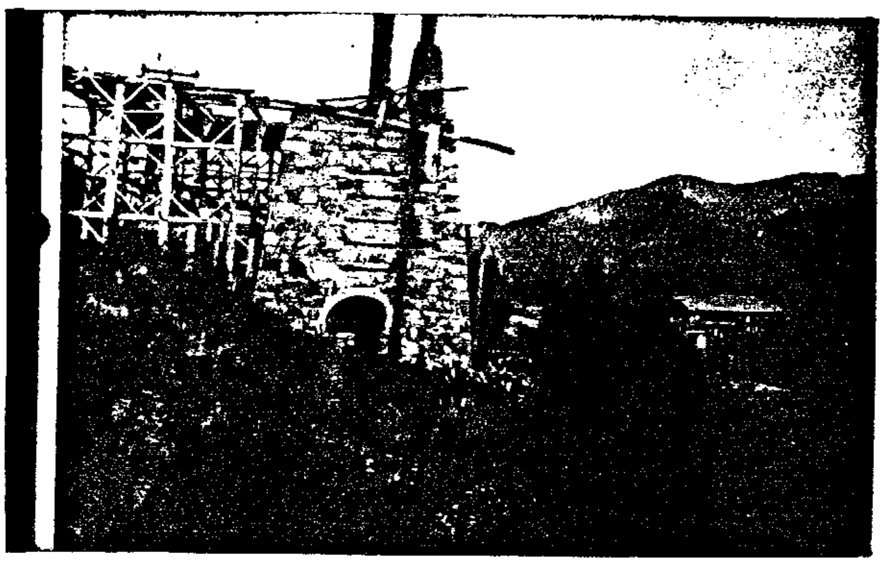
-"Adirondack Club House, near Lake Henderson." Original boarding house at upper works. E. Bierstadt, The Adirondacks: Artotype Views of the North Woods, NY, circa 1880'1 (n.d.).

Photocopy of a photograph. Photograph can be obtained by writing to The Adirondack Museum, Blue Mountain Lake, NY 12812.



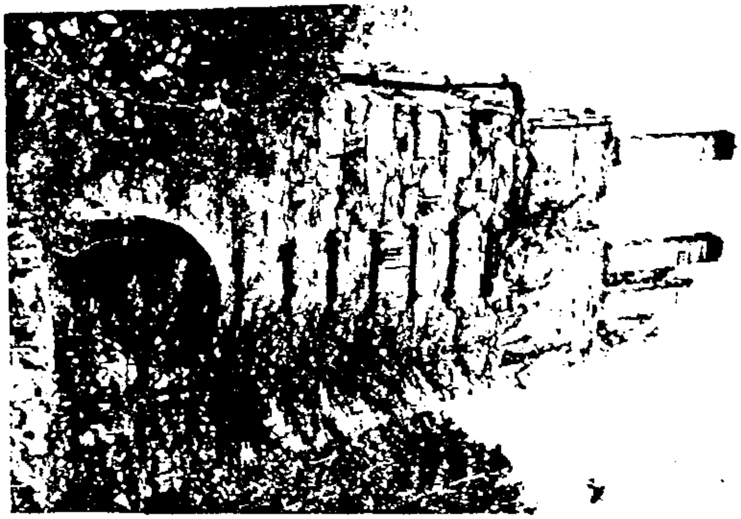
-"Old Furnace-DesertedVillage." Note Charging Bridge and Ore Stamps. View looking from north. E. Bierstadt The Adirondacks: Artotype Views of the North Woods, NY, circa 1880's, n.d.

Photocopy of a photograph. Photograph can be obtained by writing to The Adirondack Museum, Blue Mountain Lake, NY 12812.



"Ruins of Adirondack Village." #429. Copyright 1888, by S.R. Stoddard. "New" Blast Furnace, and Wheel House. Perhaps taken in 1873.

Photocopy of a photograph. Photograph can be obtained by writing to The Adirondack Museum, Blue Mountain Lake, NY 12812.



-"New"Furnace. Hearth Arch, Hot Blast Stove.